OCTOBER, 1946

Orthodontics

EDITOR-IN-CHIEF
H. C. POLLOCK

ASSOCIATE EDITORS

Oren A. Oliver James D. McCoy Charles R. Baker Joseph D. Eby
Paul G. Spencer S. A. MacKenzie Henry F. Hoffman

CONSULTING EDITOR, DENTISTRY FOR CHILDREN
Walter T. McFall

ABSTRACTS AND REVIEWS
Associate Editor, J. A. Salzmann

Office of the Editor: 8022 Forsythe Boulevard, St. Louis
Published by The C. V. Mosby Company, St. Louis

American
Journal of Orthodontics
and Oral Surgery

(All rights reserved)

VOL. 32 OCTOBER, 1946 No. 10

Original Articles

SCLEROSING TREATMENT FOR SUBLUXATION OF THE TEMPOROMANDIBULAR JOINT

WILLIAM ROSENBAUM, D.D.S.,* NEW YORK, N. Y.

ONE of the greatest rewards achieved in pursuing a sientific calling is to discover or devise a means to alleviate human suffering and to restore normal function to a disordered organ. During recent years there have been, as a boon to mankind, many discoveries of a scientific nature, such as sulfonamide products, penicillin, uses of blood plasma, and therapeutic improvement for maxillofacial conditions, especially skeletal fixation for fractures. No less important than these discoveries has been advancement in the treatment of subluxation. The action of certain drugs affords such pronounced relief to those suffering from subluxation of the temporomandibular joint that all dentists who have a real interest in the welfare of their patients should undertake the study of the newly established methods to relieve this annoying ailment. As general practitioners, they can learn the simplified technique and thus be able to use it whenever the occasion demands. No danger is involved when the technique is properly carried out. The results are astounding; the cure permanent. Because of actual experience I am in a position to emphasize these facts.

In an article on this subject, Dr. Schultz,[1] of Northwestern University, stated that during several years of experience he was successful in treating patients suffering from this ailment with injections of a sclerosing agent, namely, Sylnasol† (sodium psylliate); a specific innocuous fibrosis being developed. At that time I became interested in this form of therapy. In ten years of experience at Bellevue Hospital and New York University, I have had an opportunity to study the causes and symptoms of subluxation of the temporomandibular joint

*Professor of Clinical Oral Surgery, College of Dentistry, New York University; Associate Visiting Oral Surgeon, Bellevue Hospital.

†A product of G. D. Searle & Co., Chicago, Ill.

in more than two hundred cases. I developed a technique in which pain is minimized and with which almost incredible results are obtained; surgical intervention being thus avoided.

For an understanding of this method of treatment, it is well to review the anatomicophysiological background on which it is based.

STRUCTURE OF THE TEMPOROMANDIBULAR JOINT

The temporomaxillary articulation is quite superficial, being situated under the roots of the zygomatic arch in front of the tragus and external auditory meatus and behind the posterior of the upper part of the masseter muscle. The roof of the glenoid fossa is the floor of the middle cerebral fossa. The exact position can be ascertained by feeling for the condyle of the jaw just in front of the external ear.

The mandibular joint is made up of the condyle of the mandible below the glenoid fossa and the articular eminence on the undersurface of the temporal bone above. Posteriorly, the glenoid fossa is bounded by the delicate tympanic plate, which separates it from the external auditory canal. The roof between the glenoid fossa and the middle cerebral fossa is very thin. Between the condyle and the temporal bone there is an *interarticular fibrocartilage disc,* which divides the joint into two compartments, and the whole of which is surrounded by a *capsular ligament.* Three other ligaments add to its strength, namely, the *stylomandibular ligament,* extending from the styloid process of the temporal bone to the posterior border of the ramus; the *external lateral ligament* which is closely incorporated with the capsular ligament; and the *internal lateral ligament* (or sphenomandibular ligament) attached above to the spinous process of the sphenoid bone and below to the lingula of the mandible.

For a description of these ligaments, I refer you to Gray's *Anatomy.*

The *external lateral ligament,* which is short, thin, and narrow, is attached, above the outer surface of the zygoma, to the rough tubercle on its lower border; below, to the outer surface and to the posterior border of the neck of the lower jaw. It is broader above than below. Its fibers are situated parallel with one another and are directed obliquely downward and backward. As externally the external lateral ligament fuses with the capsular ligament, of which it is an accessory band, injury to either ligament involves the other.

The *internal lateral ligament* is attached above to the spinous process of the sphenoid bone and, becoming broader as it descends, is inserted in the lingula and margin of the dental foramen. Since its outer surface above fuses with the external pterygoid muscle, injury to the pterygoid muscle affects the external lateral ligament, and vice versa. Lower down, it is separated from the neck of the condyle by the internal maxillary artery. The external pterygoid muscle plays an important part in lateral movement. The inferior dental vessels and nerves separate it from the ramus of the jaw. The inner surface of the internal lateral ligament fusing with the internal pterygoid muscle creates a close vascular and nerve relationship. Furthermore, the internal pterygoid muscle operates in the closing of the mandible.

The *stylomaxillary ligament,* only an accessory ligament in the articulation, extends between the masseter and internal pterygoid muscles, from near the apex of the styloid process of the temporal bone to the angle and posterior border of the ramus of the lower jaw. This ligament separates the parotid gland

from the submaxillary gland. Part of the fibers that have their origin in the styloglossus muscle are attached on the inner side of the ligament. In any injury to this ligament or muscle there is a possibility of the tongue being involved.

The *capsular ligament* forms a thin loose ligamentous capsule attached above to the circumference of the glenoid cavity and the articular surface immediately in front; below, to the neck of the condyle of the lower jaw. It consists of a few thin scattered fibers. It is thickest at the back part of the articulation.

The *interarticular fibrocartilage* disc is a thin oval-formed plate of a shape resembling a jockey's cap, situated horizontally between the condyle of the jaw and the glenoid cavity. Its upper surface is concave (convex from below) toward the rear and a little convex transversely to accommodate itself to the form of the glenoid cavity. Its undersurface, where it is in contact with the condyle, is concave. At its circumference it is connected with the capsular ligament and, in front, to the tendon of the external pterygoid muscle. Attention is called to the importance of these connections. The interarticular fibrocartilage disc is thicker at its circumference, more so at the rear than at its center, where at times it is perforated. The fibers of which it is composed have a concentric arrangement, more apparent at the circumference than at the center. Its surfaces are smooth; it divides the joint into two cavities, each of which is furnished with a separate synovial membrane.

The *synovial membranes,* two in number, are situated one above and one below the fibrocartilage disc. The upper one, the larger and looser, is continued from the margin of the cartilage covering the glenoid cavity and eminentia articularis, onto the upper surface of the fibrocartilage disc. The lower one passes from the undersurface of the fibrocartilage disc to the neck of the condyle of the jaw, being prolonged downward a little further behind than in front of this joint.

The *nerves* are derived from the auriculotemporal and masseteric branches of the inferior maxillary nerve.

The *arteries* are derived from the temporal branch of the external carotid.

PHYSIOLOGIC ACTION

The joint is a bilateral condyloid articulation, permitting motion in all directions except axial rotation. The jaws may be depressed or elevated or may be carried forward or backward or from side to side. It is by the alteration of these movements, performed in succession, that a kind of rotatory motion of the lower jaw upon the upper takes place, which materially assists in the mastication of the food.

The temporomandibular joint differs from other joints in that it hangs loosely in its ligaments when at rest. Normally the head of the condyle moves in the glenoid fossa. The working of the temporomaxillary articulation can be distinctly felt in the movements of the lower jaw either vertically or from side to side. When the mouth is opened wide, the condyle advances out of the glenoid fossa onto the eminentia articularis and a depression is felt in the region of the joint. If the movement of depression is carried only to a slight extent, the condyles remain in the glenoid cavities, rotating on a transverse axis against the interarticular fibrocartilage. But if the depression is considerable, the condyles glide from the glenoid fossae onto the articular eminences, carrying with them the interarticular fibrocartilages, so that in opening the mouth wide

the two movements are combined. That is, the condyle rotates on a transverse axis against the fibrocartilage and at the same time time glides forward, carrying the fibrocartilage with it. When the jaw is elevated after forced depression, the condyles and fibrocartilages return to their original position. When the jaw is carried forward and backward or from side to side, an oblique gliding movement of the fibrocartilages and condyles upon the glenoid cavities takes place in the corresponding direction.

The lower jaw is depressed by its own weight, assisted by the action of the platysma, the digastric, the mylohyoid, and the geniohyoid muscles. It is elevated by the anterior part of the temporal, masseter, and internal pterygoid muscles. It is drawn forward by the simultaneous action of the external pterygoid muscle and the superficial fibers of the masseter muscle, and it is drawn backward by the deep fibers of the masseter muscle and the posterior fibers of the temporal muscle. The grinding movement is caused by the alternate action of the external pterygoid muscles.

ABNORMAL CONDITIONS OF THE TEMPOROMANDIBULAR JOINT

The term *dislocation* or *luxation* means an alteration in the relation of the bony surfaces composing a joint. The lower jaw is dislocated in one direction only, namely, forward. A dislocation may be caused by external violence or by muscular action, such as in convulsive yawning with muscular spasm. If the joint is subjected to violence, especially when the jaws are widely separated, the condyle may pass the eminentia articularis and slip forward through the articular ligaments into the zygomatic fossa. In a similar manner, sudden muscular spasm may displace the condyle forward into the zygomatic fossa. Such displacement constitutes a dislocation. The displacement may be unilateral or bilateral according as one or both of the condyles are involved, the latter being more common.

A complete dislocation unreduced is easily recognized by the deformity it causes. Such a dislocation is always accompanied by a tear in the ligaments of the joint, through which the condyle slips into the zygomatic fossa.

Originally, Sir Astley Cooper described a condition which he termed "subluxation," which occurs commonly in delicate women. The condition is believed to be due to the relaxation of the ligaments, permitting too free a movement of the bone and some displacement of the fibrocartilage. Others believe it is due to gouty or rheumatic changes in the joints.

Subluxation may be described as a self-reducing incomplete dislocation, and may also be accompanied by some displacement of the meniscus. Complete dislocation and subluxation often are accompanied by traumatic arthritis. The latter occurs also in cases of external violence in which neither dislocation nor subluxation resulted. In these cases the condition is usually characterized by pain, and there is a history of trauma.

Since the condyle of the jaw is in close relation to the external auditory meatus and the tympanum, any force applied to the bone is liable to be attended with damage to these parts, or inflammation of the joint may extend to the ear.

On the other hand, inflammation of the middle ear may involve the articulation and cause its destruction, thus leading to ankylosis of the joint.

In children, arthritis of this joint may also follow the exanthemas, and in adults it occurs as the result of some constitutional condition such as rheumatism or gout. The temporomaxillary joint is also frequently the seat of osteoarthritis, leading to great suffering during efforts of mastication. In a peculiar affection sometimes attacking the neck and condyle of the lower jaw, hypertrophy and elongation are present in these parts, resulting in subsequent protrusion of the chin to the opposite side.

ETIOLOGY

Subluxated joints are not rare. Slight violence may result in subluxation of the temporomandibular joint. As previously mentioned, opening of the mouth wide, as in yawning, may produce subluxation. Other causes are sudden shock accompanied by a crying out; trauma to the side of the mandible; opening of the mouth too wide as in eating an apple, or laughing heartily. A forcible or too protracted opening, as during the extraction of teeth, may be the cause, especially when nitrous oxide and a mouth prop are used. In a long dental operation for removal of the third molars, downward pressure may be so excessive as to cause subluxation of the joint. In all these circumstances the ligaments are stretched beyond their normal limits of elasticity, from which they do not usually recover unless they are adequately treated.

SYMPTOMATOLOGY

In severe illness in which suffering is intense, as in trifacial neuralgia (tic douloureux), patients wil' seek relief. Pain is one of the symptoms almost invariably present in individuals suffering from subluxating joints. Consequently, they seek medical advice early. Even many mild conditions require correction. Pain occurs when the mandibular joint is moved in opening or closing the mouth.

The deformity of complete dislocation can be seen, for generally the mouth is open and cannot be closed by the patient. Inspection reveals the head of the condyle protruding out of the glenoid fossa. The deformity may likewise be felt with the palpating finger. When the mouth is opened, the palpating finger falls into the glenoid fossa vacated by the condyle. Locking of the jaws may occur when the mouth is open or closed, in luxation or in subluxation. In cases of locked jaws, the meniscus or fibrocartilaginous disc is usually caught and folded between the head of the condyle and the eminentia articularis.

Another symptom of subluxation is the click, which may be audible at a distance of many feet and may cause considerable embarrassment. Clicking may occur during any one of three phases: first, on opening the mouth; second, on closing it, and third, on the exertion of pressure during the process of chewing.

There may be a severe ringing or hissing or air sound in the ear. The eyes may be affected. Severe headaches may occur, especially in the region of distribution of the auricular tympanal nerve, also along the distribution of the masseteric nerve involving all branches of the trigeminal nerve.

A grating sound may be present, owing to injury of the anatomical structure of the head of the condyle. The tympanic plate, lying as it does directly in front of the auditory canal, may sustain severe pressure exerted on it by the condyle, due to lack of resiliency in the ligaments holding the articulation in contact.

DIAGNOSIS

It is necessary to make a correct diagnosis, as disease may also cause discomfort in the same anatomical region as temporomandibular luxation or subluxation. The diagnosis of subluxation is easy, for the symptoms as enumerated above are characteristic, but they should always be accompanied by a careful history. An attempt should be made to trace the possible origin of the cause; the duration of the existence of the subluxation should be noted as well as its severity.

All symptoms should be considered. The indications for treatment are quite plain. They are: (1) pain, remote or local; (2) a clicking or grating noise or both in the temporomandibular region; (3) and the visible presence of deformity from excursion of the condyles of the joints, or from locking of the mouth in either the open or closed position or opening of the jaws beyond normal expectancy, with sliding to one side.

Normally, the opening of the mandible from the incisal edge of the upper teeth to the incisal edge of the lower teeth measures 35 mm. In abnormal cases I have found the measurement as much as 55 to 60 mm.; generally, 45 to 50 mm. The vertical dimension to determine if an open or closed bite exists should be noted. The distance from the pupil of the eye to the corner of the mouth should be equal to the distance from the inferior border of the ala (of the nose) to the lower border of the chin when the mouth is in normal respose. If the measurement shows an open or closed bite, the centralizing of the condyle in the glenoid fossa may be corrected by orthodontic procedure such as bite adjustment or other means.

A thorough examination of all the teeth should be included and any dental reparative procedures should be completed before treatment for subluxation is undertaken. If an edentulous condition or an open or closed bite can be corrected by artificial restoration or orthodontic prosthesis, such measures should be recommended and also carried out prior to treatment for the subluxation.

Preoperative temporomandibular roentgenograms should be taken from each side with the mouth open and closed, the excursion of the condyle in its relation to the eminentia articularis being observed. If the condyle just reaches the eminence when the mouth is open, treatment may be contraindicated, but as a rule in typical subluxation the condyle will be found several millimeters beyond the eminence, and in the closed bite it will be very often close up against the tympanic plate.

Postoperative roentgenograms should be taken in the same way as the preoperative ones, in order to note whether the excursion of the condyle has improved, that is, not abnormally leaving the fossa. The measurement of the opening and closing distance of the mandible in millimeters should be noted.

Fig. 1.—Table showing operative armamentarium.

Fig. 2.—Clinical view of patient opening the mouth beyond normal expectancy.

Fig. 3.—Measurement from incisal edges showing opening of 45 mm.

TREATMENT

Previous treatment of temporomandibular abnormalities has been largely confined to surgical intervention. The various operative measures applied in the past and still used by some operators appear to be unsatisfactory.

Fig. 4.—Facial surveyor measuring the distance from the corner of the mouth to the pupil of the eye.

Fig. 5.—Facial surveyor measuring the distance from the ala of the nose to the lower border of the chin, which gives the vertical dimension.

According to Stimson,[2] if function is poor and dislocation chronic, the joint is opened, the fossa is cleared, and the condyle replaced. If this cannot be done, one or both condyles may be excised. In chronic dislocation, Annandale[3] recommended opening of the joint followed by stitching of the meniscus to the periosteum. Ashhurst[4] advised opening of the joint and excision of the meniscus. Removal of the cartilaginous disc is a difficult procedure. The method of placing mattress sutures in the capsule is scarcely less formidable. An important disadvantage of surgical intervention is the danger arising from re-

sultant scars. Surgical methods in attempts at relief may be accompanied by complications, such as facial paralysis on the side operated upon, or a permanent salivary fistula if the parotid gland is injured. Furthermore, the close proximity of the external maxillary artery to the temporomandibular joint adds to the hazards. An ankylosis may also result, due particularly to infection incidental to the operation.

Physiotherapy, orthodontic and prosthetic devises, the application of pressure pads in front of the ears, and wiring of the jaws are among various other means that have been introduced. The best treatment known up to the time of the initial injection of a sclerosing agent was rest, but this was never very successful.

METHOD OF INJECTING SCLEROSING AGENT

Because of the numerous disadvantages encountered in surgical therapy for subluxation of the temporomandibular joint, Schultz[1] sought a conservative method of treatment. About this time there appeared prominently in the medical literature various attempts to cure hernia, varicose veins, and other conditions by the injection of some sclerosing agent. It seemed logical, therefore, that such an agent would induce sufficient thickening of the joint capsule to prevent subluxation. It was determined by experimental work that fibrosis produced by a sclerosing agent and shortening of the ligaments would stabilize the joint without deleterious effects upon joint motion or the cartilaginous surface. After an investigation and experimental tests, the drug, sodium psylliate, was selected by Schultz as a suitable agent.

This therapeutic injection method as used on the temporomandibular joint is confined to the condition of subluxation. Forms of arthritis of this joint, infection from the ear causing ankylosis, or sequelae of some constitutional disease such as rheumatism, gout, or gonorrhea should not be treated by this method. The best results are obtained in the treatment of *traumatic arthritis,* and treatment should be applied as quickly as possible after luxation or subluxation has occurred.

Unilateral subluxation should always be treated bilaterally to balance the sclerosing effect and the action of the jaw. It is very seldom that a unilateral injection is made. The contraindications for treatment are excessive motion without pain, clicking, grating, or locking, and normal motion of one joint, with excessive motion in the other joint.

A complete history is recorded, careful examination of the external auditory meatus being made, the occlusion of the teeth, the time of click, if present, being noted. The treatment consists of a few injections of a sclerosing agent into the joint cavity, which tightens the capsule. The injections should be repeated every two or three weeks until sufficient fibrosis has developed to effect a cure. Some patients require only one injection, while others need as many as four or six before improvement is evident. In patients suffering most from pain, subluxation, and clicking, the best results are usually obtained. Likewise, it is true that relief is more marked in patients who have the most severe reaction after injection.

At one time I used plain Sylnasol, but found that a severe burning sensation was produced which lasted about twenty minutes, and a soreness remained for several days. Hot compresses would be applied immediately after injection, which seemed to afford great relief. The only sedation necessary would be 5 to 10 grains of aspirin. Today, the solution has been modified so that the patient, when given the injection, is relatively free from pain.

In my method I first inject (a) 2 per cent novocain solution followed by (b) Sylnasol in combination with a base of Eucupin solution in oil, which hastens and prolongs anesthesia.

Sylnasol is sterile, stable, and nontoxic. It is not a tannic acid or alcohol solution; it contains no thymol, zinc sulfate, quinine and urea, glucose, phenol, nor any irritating mineral acid. Large amounts have been used intravenously on both animals and human beings without effect other than local sclerosis of the injected vein. The tissues will tolerate as high as 450 c.c. of the drug without any deleterious effect. The occurrence of an allergic reaction has been exceedingly rare.

The effect of Sylnasol is to produce firm mature fibrous tissues within forty-two days. It has a mild irritant action. There are no undesirable histologic changes.

Each 5 c.c. of the Eucupin base* ($C_{22}H_{34}N_2O_2$) contains:

Isoamylhydrocupreine	0.005 Gm.
Benzocaine	0.150 Gm.
Benzyl alcohol	0.250 Gm.
Oil of sweet almond q.s.	

It is an alkaloid base, which in reaction with hydrochloric acid forms the salt of Eucupin, called dihydrochloride. The base is soluble in oil and alcohols. The salt is water and alcohol soluble, with a slight acid reaction.

Eucupin remains unchanged for many hours at the site of subcutaneous, submucosal, and intramuscular injections; it affects nonmyelinated nerve fibers rapidly nad produces vasodilatation. Therefore, its use in vascular areas should be accompanied by an adequate amount of epinephrine to prevent bleeding. The addition of from 2 to 10 minims of this Eucupin base to each 10 c.c. of procaine is permissible to hasten the onset of anesthesia. Eucupin is less than one-sixth as toxic as cocaine. A 1:1,000 solution of Eucupin hydrochloride produces the same degree of anesthesia as a 2 per cent solution of either cocaine or procaine. There are not reports of idiosyncrasy to Eucupin in the literature.

TECHNIQUE

The operating table is prepared with six sterile applicators, three for each side, which are used for skin sterilization, and with a bottle of collodion and sterile sponges. Two sets of 1 c.c. tuberculin syringes, with two 26 gauge needles, 1 to 1½ inches in length, and two 23 gauge needles of the same length are ready for use. The 26 gauge needles are for the injection, and the 23 gauge needles are to pick up the heavy oily solution. There are, in addition, two novocain carpules, one rubber-capped bottle containing Eucupin in oil (5 per cent solution) and another rubber-capped bottle containing 5 per cent Sylnasol. The

*Rare Chemicals Inc., Flemington, N. J.

Fig. 6.—Skin sterilization at the area of injection.

Fig. 7.—Palpating the right side between the tragus and external ear, mouth prop being inserted.

Fig. 8.—Palpating the left side.

rubber-capped bottles are swabbed with alcohol applied with sterile sponges. The facial surveyor for measuring the vertical dimension, a millimeter rule, and a mouth prop are also at hand on the table.

Four minims of the 2 per cent novocain solution are shot from the novocain carpules into the barrels of No. 1 and No. 2 syringes with the 26 gauge needles attached. Four minims of Eucupin in oil are drawn up into the barrels of the No. 3 and No. 4 syringes, with the 23 gauge needles, and then 6 minims of Sylnasol are picked up.

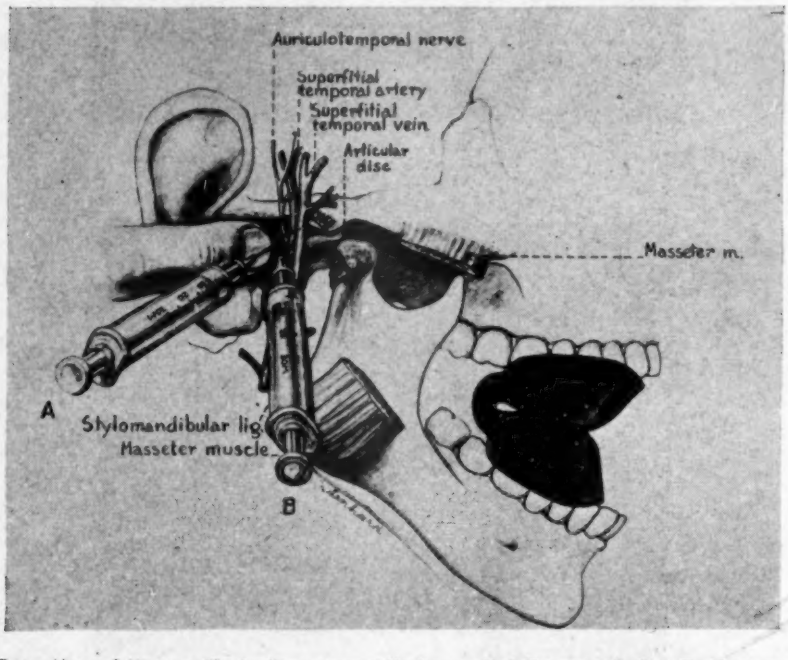

Fig. 9.—*A*, Insertion of the needle to the zygomatic bone slightly anteriorly; *B*, then posteriorly to upper two-thirds of the glenoid fossa.

The patient is prepared with a gown and head cap. The skin area between the tragus and the external ear on both sides is sterilized with iodine and alcohol. Sterile pads, about 3 inches square, are placed over the sterile area and held in position under the head cap. The operator scrubs his hands and sterilizes them with alcohol. To inject on the right side he stands a little to the rear of the patient; he palpates the area between the tragus and the external ear for the excursion of the condyle, with the index finger of the left hand. On the left side he stands a little to the front of the patient, and palpates with the index finger of the left hand, holding the syringe in the right hand. The point of injection having been located, the nurse places the prop in the patient's mouth to hold it open. The syringe, with the 26 gauge needle, containing the novocain solution, is inserted and directed upward and slightly anteriorly until it comes in contact with the bone of the zygomatic arch, then withdrawn slightly directed upward and slightly posteriorly to the upper two-thirds of the glenoid fossa. To prevent injecting into the blood vessel it is necessary to aspirate by withdrawing the needle very slightly, if blood is obtained. Two to 4 minims of

Fig. 10.—Shooting novocain into syringe barrel which has the 26 gauge needle attached.

Fig. 11.—Inserting the 26 gauge needle upward and slightly anteriorly till it touches the zygomatic arch; then it is directed upward and slightly posteriorly to the upper two-thirds of the glenoid fossa; then the novocain is injected.

Fig. 12.—Protruding needle left in position, the syringe barrel having been removed.

novocain are deposited slowly and the barrel is withdrawn, leaving the needle in position.

The nurse now hands the operator the syringe barrel containing 4 minims of 5 per cent oil solution of Eucupin and 6 minims of 5 per cent solution of Sylnasol, all having been shaken in the barrel. This is attached to the protruding needle and the mixture is slowly injected. After the needle has been withdrawn, the finger is pressed gently over the area of puncture. Collodion is applied and the mouth prop removed. The same procedure is repeated on the other side.

Fig. 13.—Syringe barrel containing the Sylnasol Eucupin in oil, being attached to the protruding needle.

Fig. 14.—Showing the head cap, sterile pads, and the expression of the patient immediately after injection.

The patient is instructed to apply hot compresses if there is any pain, and to take 10 grains of aspirin if necessary. If the pain is severe, Imadyl Unction* can be applied with hot compresses, and occasionally stronger sedation is prescribed. The patient is restricted to a soft diet and is instructed to refrain from

*Hoffmann-La Roche, Inc.

excess motion of the jaws. Due to tightening of the mensicus the posterior teeth may occlude abnormally and there may be inability to open the mouth twenty-four hours after injection.

The patient should report in one or two weeks for an examination so any development of symptoms might be checked. Depending upon the symptoms, a second injection is carried out after an interval of three weeks. The second and third injections are much more difficult to make because the head of the condyle now is in very close apposition to the glenoid fossa and does not separate from it when the mouth is opened.

Fig. 15.—Showing the incisal measurement of 23 mm. one year after injection.

Fig. 16.—Clinical picture of opening the mouth, one year after injection.

POSTOPERATIVE REACTION

The majority of patients have no complaint other than some interference with chewing during the remainder of the day following the injection, as the articulation seems to tighten in twenty-four hours, but new tissue requires forty-two days to mature.

There may be swelling in the injected region. If this does occur, it usually lasts three or four days. The bite of the teeth, noted one week after treatment, may be temporarily shifted slightly forward and downward or to one side, depending upon the degree of the reaction. The molar teeth may not come into occlusion because of the thickening of the capsule, which inconvenience is only temporary.

Fig. 17.—Two and a half years after injection; incisal measurement of 27 mm.

Fig. 18.—Clinical picture of opening the mouth, two and a half years after injection.

As an aid to the general practitioner, and especially to the prosthodontist, this method is very effective in cases of patients unable to register centric relation, particularly in edentulous mouths. After one injection into each joint, there is much less difficulty, as the condyles become more centralized in the glenoid fossa, and the excursion becomes limited.

REPORT OF CASES

Case 1.—July 11, 1944: About a month ago the patient, J. T., 19 years old, on yawning heard for the first time a cracking noise on the left side, which has

continued ever since. Her mother became anxious and sent her to a dentist, who thought the noise was due to a dry joint and suggested the use of Vitamin B.

Examination.—Vertical dimension normal. Mouth opens to 45 mm.; the jaw slides to the right. The patient feels as though she twists her jaws. In the upper arch all but the wisdom teeth are present. No wisdom teeth in lower arch, and lower left second molar is missing.

Roentgenogram showed in open bite the condyle on the left side at the articular eminence, and on the right side beyond the eminence. In closed bite

Fig. 19.—Preoperative roentgenogram of right side, open bite, showing excursion of the condyle beyond the eminentia articularis.

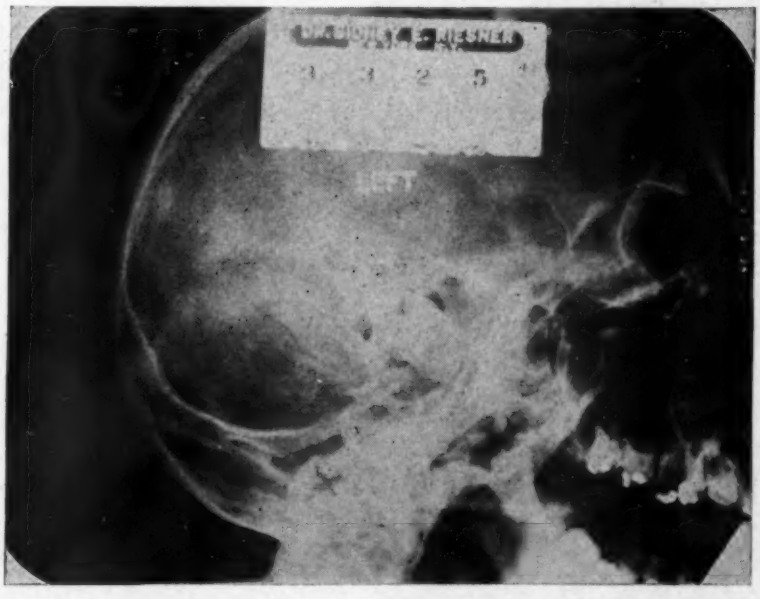

Fig. 20.—Preoperative roentgenogram of left side, open bite, showing excursion of the condyle beyond the eminentia articularis.

the condyle on the right side does not centralize in the glenoid fossa; it remains inside and close to the eminence. On the left side the condyle does not quite reach all the way in the fossa, but the condition is better than on the right side.

Treatment.—A week later, July 18, 1944, bilateral injections of 2 per cent novocain followed by 6 minims of 5 per cent Sylnasol solution and 4 minims of Eucupin in oil were given. There was no pain; the operation was uneventful. The patient was smiling after the injection.

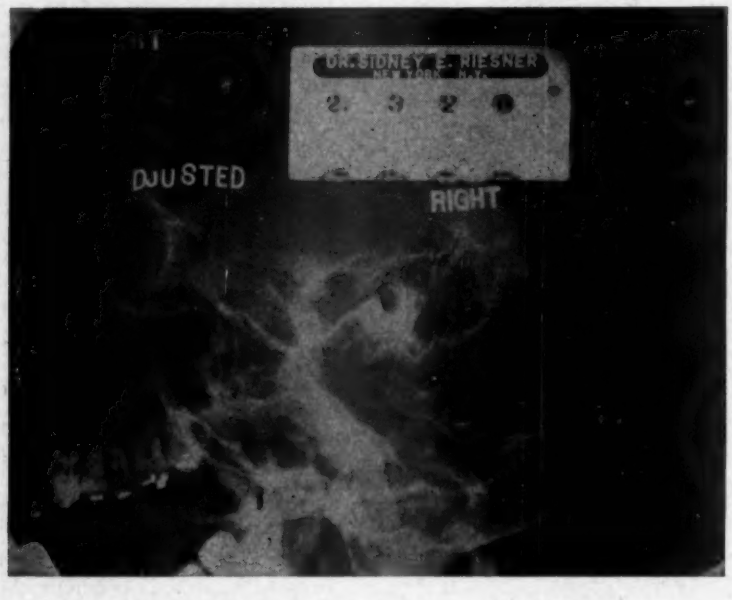

Fig. 21.—Postoperative roentgenogram of right side, open bite, showing limited excursion of the condyle up to the eminentia articularis.

Fig. 22.—Postoperative roentgenogram of left side, open bite, showing limited excursion of the condyle up to the eminentia articularis.

July 25, 1944: Mouth opens to 20 mm. The cracking noise on the left side has disappeared. The patient no longer has a feeling as though the jaws were twisting.

Postoperative Effect.—There was slight soreness in the area of injection and slight swelling which lasted for two or three days. Both have now disappeared. Patient shows great improvement. No subluxation is noticeable on opening and closing of the mouth.

Aug. 1, 1944: Mouth opens to 25 mm. No cracking nor twisting of jaws occurs. The only adverse symptom is soreness on the left side.

Sept. 26, 1944: When the patient chews on the left side, the joint on the right side occasionally clicks. Mouth opens to about 27 mm. Otherwise there is marked improvement. Second injection given bilaterally.

Jan. 16, 1945: Mouth opens to 24 mm. No adverse symptoms are present.

May 1, 1945: Patient complains of slight pulsation in right ear, especially on lying down. Mouth opens to 34 mm. She is advised to have a third injection.

Aug. 14, 1945: On right side there is a slight air sound. Third injection given bilaterally.

Sept. 26, 1945: Mouth opens to 25 mm. No adverse symptoms observed.

CASE 2.—March 14, 1944: At least ten years ago, the patient, E. B., aged 27 years, noticed during a dental operation that her jaws twisted and clicked when closing (in so far as she can remember). She would notice the same condition on opening her mouth for dental treatment. Two years ago, extraction of upper left molar was attended by discomfort on left side. Six months later there was clicking on the left side. During the last five or six months the click in mastication is so loud that it is noticed by others at the table. There is an air sound like the ocean in both ears. The ears feel as though they opened occasionally. Hearing seems better, especially in the morning. The maxillary sinus, mainly on the left side, is involved. There are a mucous dripping and discharge from the left nostril. Each morning the patient also has a very severe headache. On damp days she feels ill on getting up.

The left eye has been turning. An ophthalmologist suggested exercises for correction.

Examination.—The patient has good composite set of teeth. Vertical dimension is normal. The mouth opens to 55 mm.

Roentgenograms showed in closed bite the condyle in fairly normal position in glenoid fossa. and in open bite right condyle moves beyond the articular eminence, left side more normal.

Treatment.—March 21, 1944: Premedication, 10 grains of chloretone. Bilateral injections of novocain followed by Sylnasol and Eucupin. No pain on injection. No postoperative discomfort.

April 11, 1944: Since the injection, the eye has straightened and feels much better. Clicking returned; also headaches. Patient feels the condition has recurred. She hears no air sounds but ear gives a sensation of being closed. Premedication: 10 grains of chloretone. Second injections of novocain, then Eucupin and Sylnasol.

April 18, 1944: Slight headaches still occur. Ear sound has disappeared. No clicks present. Subluxation has cleared up. Mouth opens to 25 mm.

May 1, 1944: Third injections given. No pain occurred. Patient very comfortable.

May 16. 1944: No pain. Left eye much improved. There is no click on left side. Headaches much less severe, ear condition good; no closed feeling.

June 13, 1944: General symptoms: Headaches less but pain located mostly over left eye and in left nostril. Left eye shows great improvement; no turn-

ing. Left sinus is more infected than right. No air sounds in ear; it feels clear. Patient noticed general improvement of skin. Eyes are clear.

Adverse Symptoms.—On left side slight click still occurs. Discharge from left side of nose. Mouth opens 40 mm. Fourth injection given bilaterally. After injection on left side patient complained of slight ache in ear. She also felt dizzy; weak feeling and tightening of jaws. This is the first time she has had a reaction of nausea after injection. The sensation persisted for some time. Hot packs applied at sites of injection. Patient also given aromatic spirits of ammonia.

June 27, 1944: Swelling on left side more severe than at any previous time. Jaws were severely locked for five to six days. Now patient can open mouth to 25 mm. No temporomaxillary displacement is present when mouth is closed. A great deal of pain on left side. There is marked improvement in subluxation.

Aug. 8, 1944: Mouth opens to 35 mm. The greatest improvement, in patient's opinion, occurred in condition of eyes. She has been nearsighted since birth and could read only with glasses. Now she can read without them. Left eye does not turn as it did before. Headaches are much less frequent. She now wakes up feeling very well. She is 100 per cent better. Nervous condition is much improved.

CASE 3.—About two years ago, the patient, A. H., aged 27 years, noticed that her jaws started snapping on right side. This is possibly due to dental operation on posterior teeth about two and a half years ago, when mouth was kept open for a long time. Bone snaps and cracks on right side when she chews, yawns, or laughs.

Examination.—Mouth opens to 45 mm. Vertical dimension normal. Teeth and occlusion good.

Roentgenograms showed that in open bite the condyle is far out to eminence, and in closed bite it is close to tympanic plate. When mouth is open, condyle shifts to right side.

Treatment.—Nov. 21, 1944: First injection given bilaterally.

Nov. 28, 1944: Mouth opens to 18 mm. Vertical dimension normal. Snapping on right side has disappeared. No cracking on right side. Ears are sensitive when patient chews. Median line normal. Eyes are brighter. Pain in ears may be due to injection.

Dec. 12, 1944: Mouth opens to 20 mm. It does not shift to right, nor snap. Ears not sensitive.

Jan. 2, 1945: Mouth opens to 21.5 to 22 mm. No snapping, no cracking. No shifting to right side. Ears not sensitive when patient chews. Pain in ear has disappeared as well as all other symptoms. Patient looks brighter and is cheerful.

Jan. 23, 1945: Mouth opens to 22 mm. No complaints. No symptoms. On hard biting on right side at a little below articulation patient has a pinched feeling occasionally.

Feb. 20, 1945: Mouth opens to 23 mm. Symptoms negative.

March 27, 1945: Roentgenograms: In closed bite both condyles seem to be centrally located. In open bite both condyles do not leave the glenoid fossa and are situated inside the eminentia articularis.

April 10, 1945: All symptoms negative.

April 17, 1945: Mouth opens to 24 mm.

June 5, 1945: Symptoms negative.

July 10, 1945: Mouth opens to between 27 and 28 mm. Symptoms negative.

This treatise is offered as a contribution to the advancement of the dental profession in giving aid to the public, because of the gratitude of some two hundred patients with subluxation of the temporomandibular joint, who have been relieved of suffering and discomfort by a simple technique of treatment without surgical intervention.

I wish to express my deep appreciation to Dr. Leo Winter, Chief of Bellevue Hospital Oral Surgery Service, for his encouragement in my endeavors during the past ten years; to Dr. Sidney Riesner, who aided in the preparation of the roentgenograms, anatomical cuts, and motion pictures; to Alvin Taylor, my photographer. To all others whose interest and assistance contributed to the completion of this paper, I tender my thanks.

My hope is that others may benefit from my experience and believe in the efficacy of this form of therapy as confidently as I do.

REFERENCES

1. Schultz, Louis W.: A Curative Treatment for Subluxation of the Temporomandibular Joint or Any Joint, J. A. D. A. 24: 1947, 1937.
2. Stimson: Cited by Blair, Vilray, and Ivy, Robert: Essentials of Oral Surgery, St. Louis, 1923, The C. V. Mosby Co., p. 190.
3. Annandale: Ibid.
4. Ashhurst: Ibid.

111 East 56th Street

THE EFFICIENCY OF THE RUSSELL ATTACHMENT

JACOB STOLZENBERG, D.D.S., BROOKLYN, N. Y.

ELEVEN years ago this writer[1] reported the Russell attachment (Fig. 1) with enthusiasm for its unique simplicity. Today, after many years of continuous use of this attachment, I endeavor to report and demonstrate its efficiency and the value of its precision and timesaving qualities.

Successful orthodontic results have been accomplished by various appliance techniques. There are several ways of reaching an objective. Some may adopt a long course, some a roundabout way, and others will look for short cuts. Each in his endeavor will reach the same destination. In orthodontics there have been many philosophies of mechanical therapy, and each in the hands of its respective operator has proved successful.

For the past twenty-five years the writer has had the opportunity to use almost every type of appliance; of the numerous appliances used, the Russell attachment has proved most satisfactory for the labial arch technique. It has the advantages of all the other labial attachments, and, in addition, can be handled with less time and effort, and lends itself to various applications with the greatest efficiency.

The Russell attachment is of two types: one, an 0.022 by 0.028 channeled block for the edgewise technique; and the other, an 0.022 by 0.036 for the ribbon arch wire. The attachment in the molar or the anchor teeth is larger than the anterior ones and is either 0.040 channeled, or 0.022 by 0.028 channeled.

The 0.040 Russell molar attachment is used for the 0.040 round labial arch or the ribbon arch. For the edgewise technique the 0.022 by 0.028 attachment is used. No matter which labial procedure is employed, the Russell attachment affords simple and easy application.

In order to align teeth or move them posteriorly, the multiple band technique is best employed with the Russell attachment bands. It is the writer's preference to use the 0.036 attachment bands on the maxillary teeth, and the 0.022 by 0.028 attachment on the mandibular teeth for the edgewise technique.

In an endeavor to conclude a satisfactory result, the operator does not stop to evaluate the nervous strain imposed upon himself by the tedious manipulation of some of our orthodontic mechanisms. The Russell attachment by virtue of its design lends itself to simple handling and innumerable possibilities. In many instances, in comparison with other attachments, it reduces operating time at the chair conservatively by 50 per cent or more.

Presented before the Washington-Baltimore Society of Orthodontists, May 20, 1946.

Another factor is the consideration of the patient and his reaction to long-drawn-out chair operations. Children can take a great deal of what we might call punishment. We sometimes are not apprehensive of the hardship to which we subject our patients in our endeavor to reach out for an objective. We lose sight of the fact that we are dealing with timid souls. The hardships thus inflicted on the patient may in turn result in his unfavorable reflection on orthodontics.

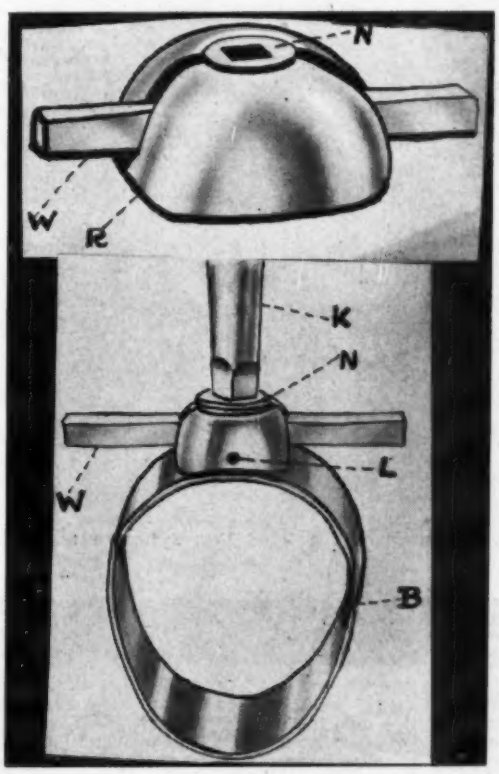

Fig. 1.—*R*, Russell molar lock; *N*, nut; *W*, wire; *K*, key; *B*, band; *L*, hole in block for ligature wire.

For edification, it would be best to describe a case report employing the routine procedures, impressions, roentgenograms, and photographs. After the study models are completed, an occlusal chart is graphed as described by the writer[2] in 1935.

After the bands are set, a light resilient arch wire is inserted. We usually commence with an 0.016 round wire and change successively to 0.018, 0.020, 0.022, and then the ribbon or the edgewise, depending upon the choice of the operator.

These attachments can be used for the twin arch wires of 0.010 (each wire) from molar to molar instead of using the combination twin arch wire for the anterior portion and the 0.036 tubing for the lateral portion.

If the dental arches require more than 4 mm. of expansion, it is best to use a Mershon lingual appliance for lateral development. At the same time,

preparations are made for 0.036 Russell bands on the maxillary central and lateral incisors and first premolars. On the maxillary molar bands we prefer to attach 0.040 Russell bands at all times. This being a timesaver should the operator decide to change to a labial technique after treatment has been instituted with a lingual appliance.

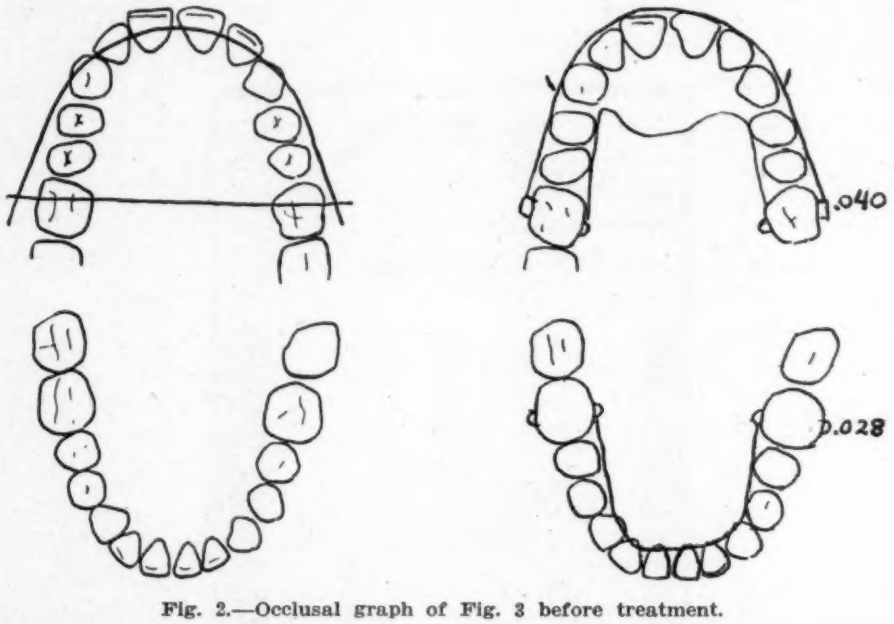

Fig. 2.—Occlusal graph of Fig. 3 before treatment.

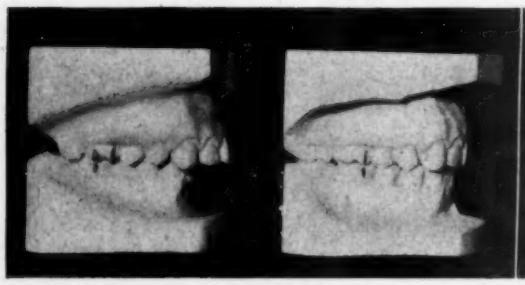

Fig. 3.

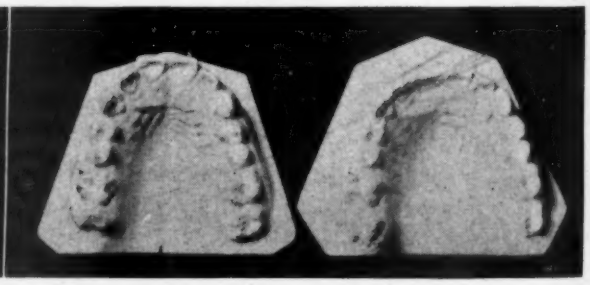

Fig. 4.

Fig. 3.—Showing side view of Class II, Division 1 case, before and after treatment. Patient was 14 years of age before treatment.

Fig. 4.—Showing occlusal view of maxillary arch before and after treatment.

Treatment is instituted with an 0.016 round labial wire, and changes are made for the reception of the ribbon wire for the maxillary arch.

In order to move the maxillary molars posteriorly, a spring coil (*S*) is inserted between the first maxillary premolar attachment and the first molar. The nut *B* is firmly secured in the first premolar attachment, immobilizing that tooth. The nut is loosened in the molar attachment to permit distal movement of that tooth. Number 5 elastics (*E*) are used from a hook (*SP*) on the maxillary labial in the vicinity of maxillary canines to buccal spurs on the mandibular molar teeth. This counteracts the forward thrust of the

coil spring, and directs the force posteriorly, thus creating a space between the first premolar and the first molar (Fig. 6). These coils are changed as frequently as is required to bring the molar into its proper mesiodistal relationship (Fig. 5). This is accomplished by removing the nut *A'* from the molar attachment *A*, and lifting out the arch, and changing the coil and replacing the

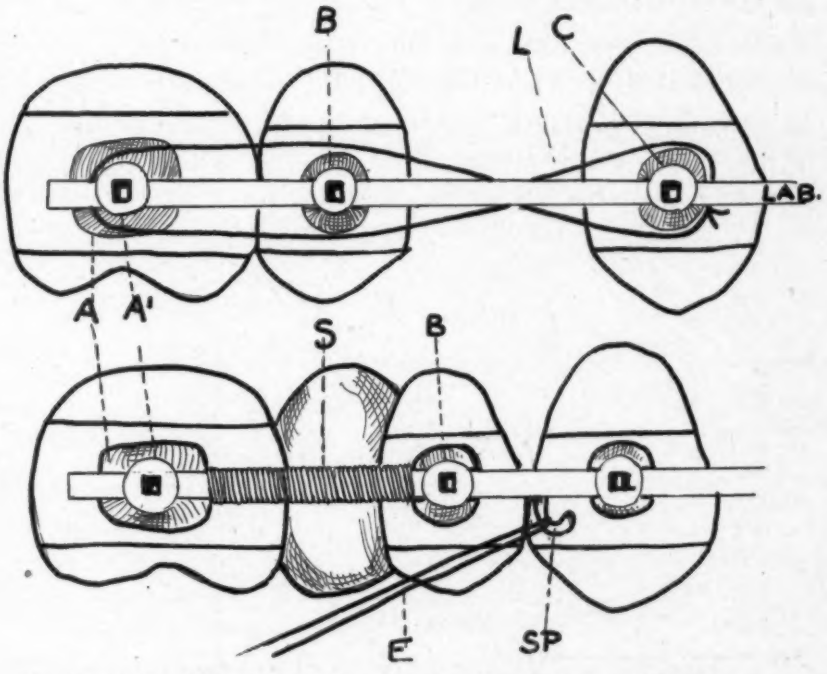

Fig. 5.—Above: To close space—between second premolar and canine, Nuts *A'B* locked, Nut *C* loose. *L*, ligature; *A*, Russell molar attachment; *LAB*, labial arch.
Below: To open space—Nut *A'* loose, Nut *B* locked. *S*, Coil spring; *SP*, spur on labial; *E*, elastic.

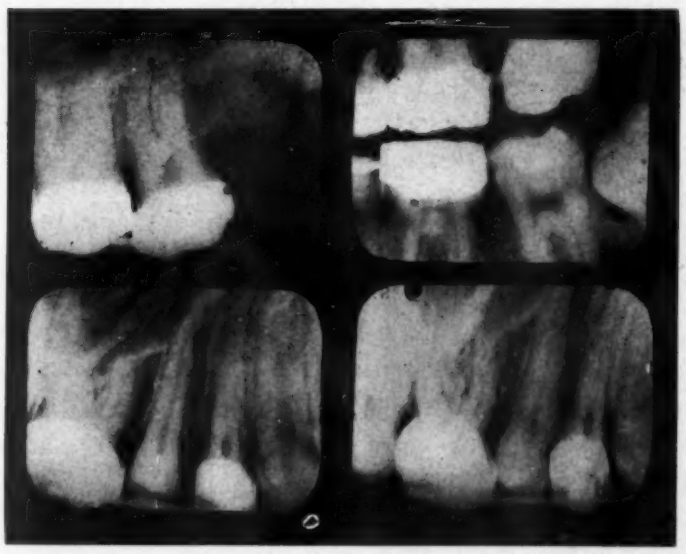

Fig. 6.—Lower right: X-ray before coil spring insertion. Lower left: Space created by use of coil spring. Similarly in upper two x-rays.

nut *A'*, leaving it loose. This takes but a short time and does not require the removal of the entire appliance to make the adjustment (Lower, Fig. 5). When the movement is completed, the coil is removed, the molar nut is firmly stopped, and the premolar nut *B* is loosened. The premolar is then ligated to the molar by means of grass-line ligature on the labial side, thereby bringing the premolar distally, and closing the space.

Fig. 5 shows a schematic drawing illustrating the action.

To complete the retraction of the maxillary anterior teeth, a dual labial arch can be used (Fig. 7) which consists of two lateral ribbon segments, with intermaxillary spurs (*B'*) in canine area. The anterior segment may be of a smaller dimensional wire with tubes (*C*) attached, and a hook (*B*) bent in ends of the wire. The posterior lateral segments are inserted into the tubes (*C*).

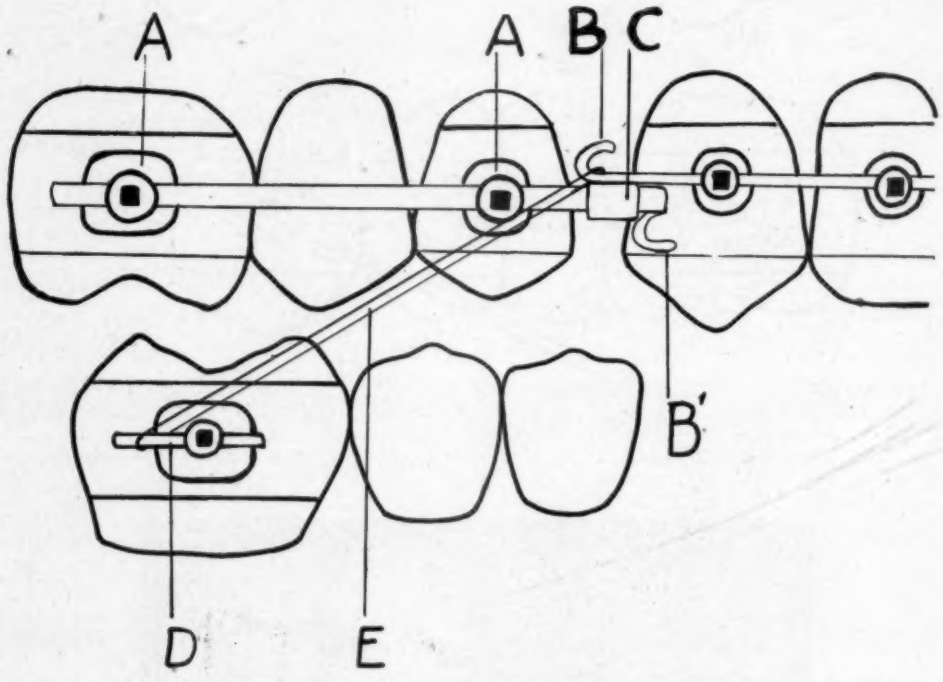

Fig. 7.—*AA'*, Nuts; *B*, anterior section intermaxillary spurs; *B'*, posterior section intermaxillary spurs; *C*, tube, soldered to anterior section.

With the dual arch, the nuts in the first molars and premolar attachments (*A*) are tightened, thus stopping the movement of both posterior segments. Class II elastics from spurs (*B*) are used to retract the maxillary anterior teeth. Another way to retract the anterior teeth is to use a single arch and release the nuts in the posterior attachment, thus permitting the arch wire to glide through the molar attachments until the anterior teeth are retracted into position by intermaxillary elastics. When all spaces are closed, the appliances are removed, and a Hawley bite plate is prepared.

In the mandibular arch, unless there is a marked curve of Spee, the writer uses a Mershon lingual appliance with Russell 0.022 by 0.028 buccal

attachments on the molar bands. This has a twofold purpose, first in the event that the operator should decide to use a multibanded or labial appliance; second, the attachment serves to hold a piece of wire as an intermaxillary spur (Fig. 7,*D*).

A word in passing in regard to the handling of the key and the nut. In order to obtain satisfactory results with the Russell attachment, the key must be firmly pressed into the nuts before turning. Failure to do this will result in a rounding out of the square orifice of the nut, which will render it inoperable.

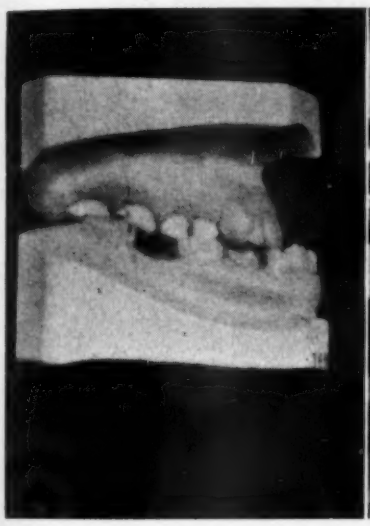

Fig. 8.

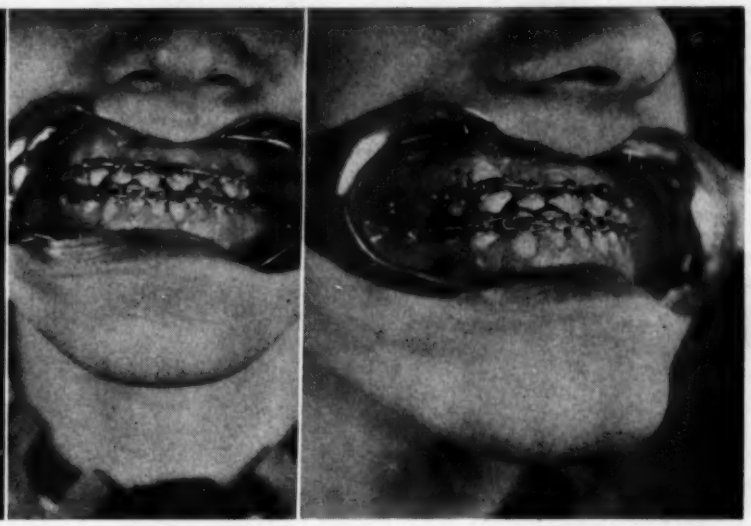

Fig. 9.

Fig. 8.—Before treatment.
Fig. 9.—During treatment.

Figs. 8 and 9 show a complicated case handled with the Russell attachments, the ribbon arch for the maxillary teeth, and the edgewise wire for the mandibular teeth. The purpose in showing this case is to demonstrate how a difficult task can be handled with ease, producing a satisfactory result with a minimum of effort and a maximum of efficiency. In this case the response was so great that the operator changed his course of treatment from a radical to a conservative procedure. It was the original intention to submit that patient to a mandibular resection, but by the good grace of the efficient and simple handling with the Russell attachment, the operator was able to accomplish this result without surgical interference.

The following are some of the auxiliary timesaving actions that can be carried out with these attachments.

1. To stop action of the labial without soldering a stop on the arch wire anterior to a buccal tube, or to hold a labial in position by simply tightening the nut on the attachment of the tooth or teeth in question.

2. To remove arch ends to insert coils or to adjust a spring loop without disengaging the entire appliance.

3. Sectional arch therapy. The following procedure is recommended when the operator is desirous of using a sectional appliance for a single tooth movement. Assuming it is a maxillary canine, and there is sufficient room for its proper positioning, the molar, premolar, and canine teeth are banded. Banding of the first premolar is optional. A resilient wire, or a ribbon wire can be used.

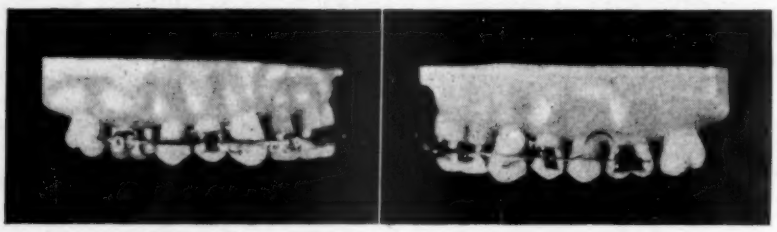

Fig. 10.—Left: Showing Russell attachment on molar. Right: Showing buccal tube with loop spring.

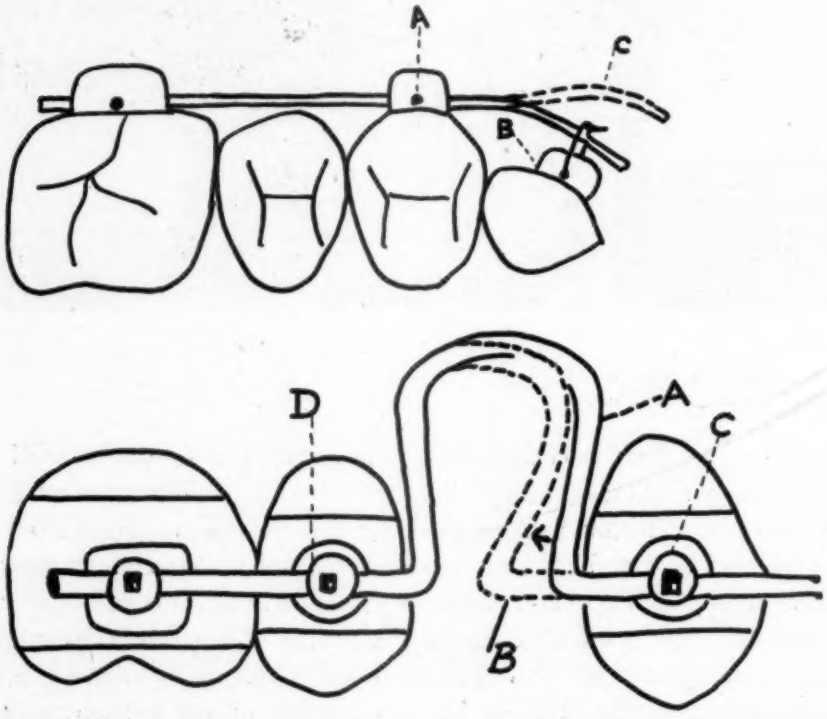

Fig. 11.—Upper: Sectional arch to bring a single tooth into position. *A*, Russell lock; *B*, ligature hole in lock; *C*, active position of wire.
Lower: Resilient loop to open or close spaces.

The molar lock is stopped, and the free end of the sectional wire is adjusted away from the tooth to be moved. It can be directly engaged, or ligated as illustrated in Fig. 11, Upper. The successive adjustments are similar until the tooth is in position. The wire is then rendered passive for retention by tightening the nut.

The loop in Fig. 11, Lower, can be used either to open or to close a space. To open the space, the molar nut and nut *D* are stopped, part of loop *A* is

moved into active position *B*, and nut *C* is then stopped. The action will direct tooth with nut *C* to move mesially. To close the space, the loop is designed similar to *B*, the loop portion of the loop is moved apart, and nut *C* is tightened. The tooth with nut *C* will move distally to close the space.

4. To open space (a) for impacted or missing teeth, (b) for missing maxillary lateral incisors. Coil springs are an invaluable aid for opening or closing spaces (Fig. 12). For opening spaces, the coil is stretched about one and one-fourth to one and one-half times the space and is inserted by freeing one end of the arch and placing the coils in their respective places. To close spaces, we use a coil which is shorter in length than the space, and is inserted on the labial. The ends of the coil are annealed and straightened, and the free ends are engaged in the Russell lock under tension by stretching the spring. The reaction of drawing the teeth together is quite obvious.

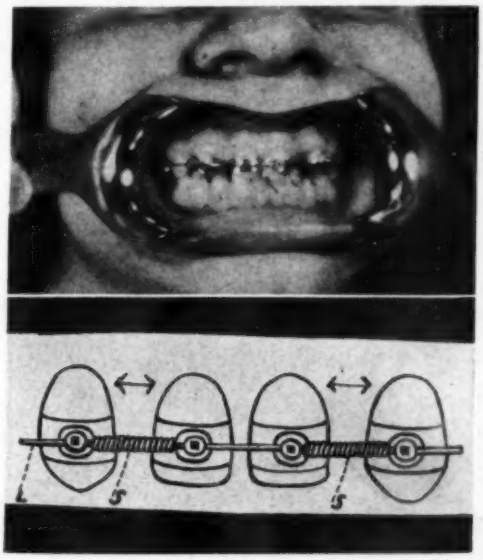

Fig. 12.—Showing spaces created for missing lateral incisors with coil springs on labial. *S*, Coil spring; *L*, labial.

5. Using twin labial arch for individual tooth movements or general alignment. The twin arch principle can readily be used with the Russell attachment. A twin wire of 0.010 up to 0.018 can be used for tooth alignment. A piece of wire of the selected gauge is doubled upon itself, and the free ends are soldered or welded. Then the wire is adapted to shape and is inserted into the brackets. In some cases where individual tooth movements are required, an 0.018 wire is shaped and then doubled upon itself (Fig. 13). The arch end is inserted in the molar attachment *A*, and the free end is engaged in the canine, as illustrated in the drawing. This can be used for various tooth movements.

6. The buccolingual torque can be regulated gently by a slight turn of the nut (Fig. 14) with the key, *K*; the ribbon wire is indicated by the letter *R*; the dotted portion shows the accomplished tooth movement. The Russell attachment lends itself to the edgewise technique for torquing and tip-back bends.

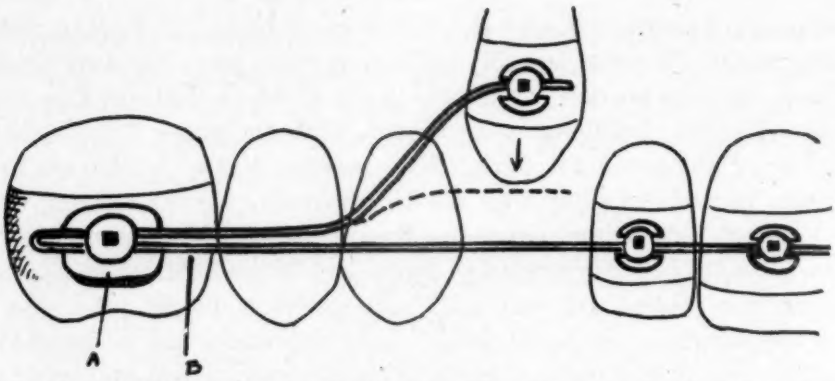

Fig. 13.—*A*, Russell lock; *B*, 0.018 doubled for elongation of a cuspid with a free end.

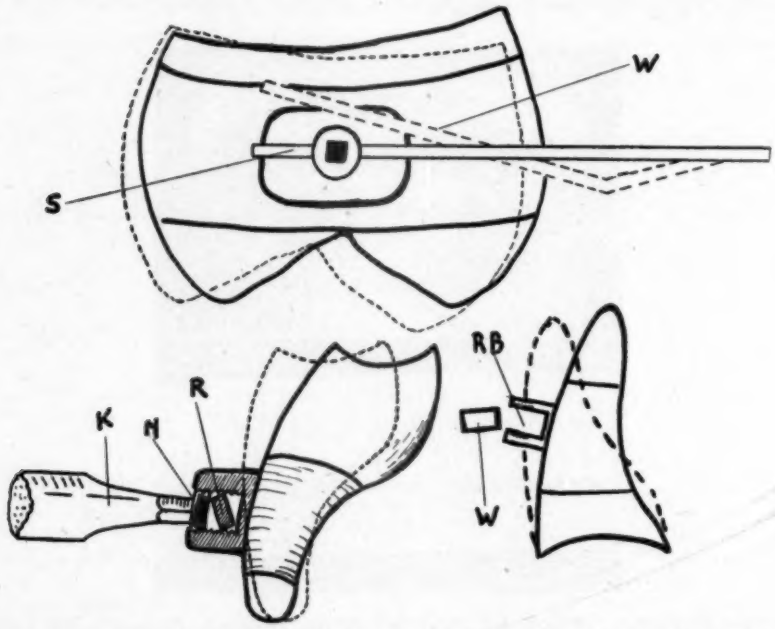

Fig. 14.—Showing torque with Russell attachment. *S*, Slot; *W*, tip-back wire; *K*, key; *N*, nut; *R*, ribbon wire; *W*, edgewise wire; *RB*, Russell bracket.

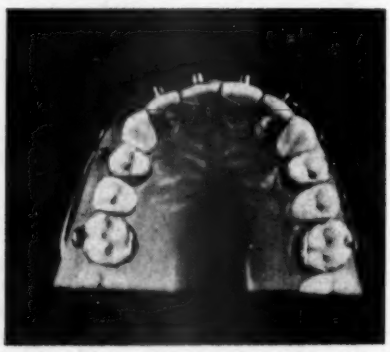

Fig. 15.—Showing one side of arch end out for expansion.

7. For expansion or contraction of the labial arch wire. The entire arch wire can be removed from the attachments rapidly and with ease to adjust the appliance, or an adjustment can be made by removing the nuts from one or both molar attachments, then manipulating the wire and replacing the arch ends and the nuts.

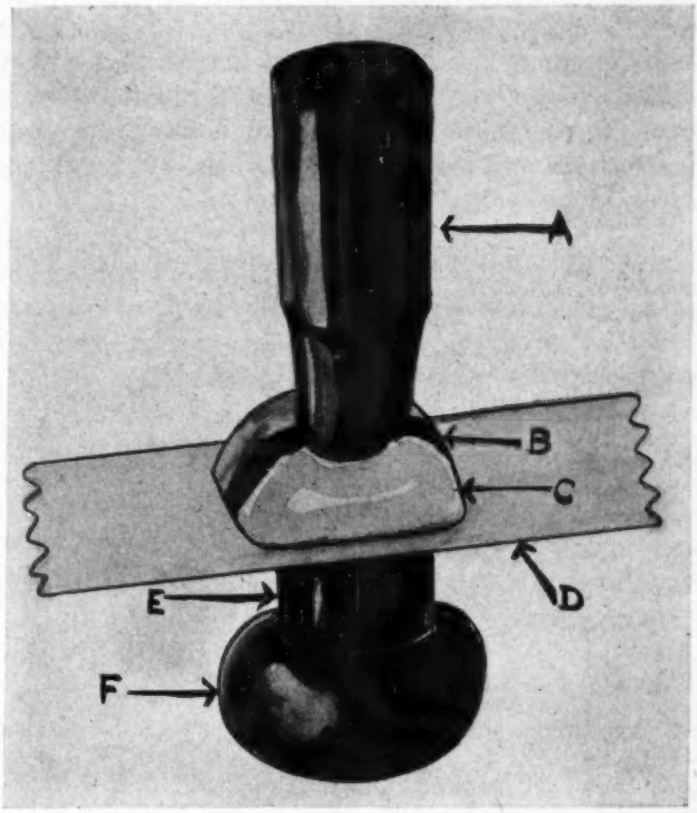

Fig. 16.—*A*, *F*, Copper points; *B*, slot in Russell attachment; *D*, band material; *E*, carbon secured in copper (*F*).

Russell attachments are of precious material and, can readily be attached to stainless steel bands with a spot-welding machine (Fig. 16). The upper copper part (*A*) is shaped to fit slot *B* of the Russell attachment. The lower copper part (*F*) is cast* around a piece of carbon (*E*) about 3 mms. in diameter. The Russell attachment and the stainless steel band material, *D*, are securely placed between the points. Stainless steel flux is placed around the junction of the attachment and the band material, *C*. A piece of stainless steel solder is held at the junction at the same time that the current is applied. A very firm solder joint will result.

In this age of progressive mechanism, the objective invariably is to obtain the best results in the shortest time. That also includes the operating time or time spent at the chair, a potential factor in removing and inserting appliances.

*Casting suggested by Dr. J. Green, New York, N. Y.

With the Russell attachment, there is no hestitancy on the part of the operator to make an adjustment because of the lack of chair time or because of fatigue.

The following advantages of the Russell attachment can be noted:

1. It is simple to operate.
2. It is applicable to various tooth movements: torque, immobilization, axial correction, expansion, contraction, and controlled movements.
3. It can be salvaged and reused.

In conclusion, I would like to say that I am satisfied with the results of the Russell attachment and can accomplish all orthodontic movements with this labial technique. Furthermore, at the end of a day I do not feel tired or fatigued from strenuous and tedious manipulations.

REFERENCES

1. Stolzenberg, Jacob: The Russell Attachment and Its Improved Advantages, INT. J. ORTHODONTIA 21: 837, 1935.
2. Idem: Orthodontic Planning With the Dental Copy Scope, D. Items Interest 57: 1079, 1935.

ONE NEVINS STREET

THE VALUE OF MODEL EXPERIMENTS ON TOOTH MOVEMENT

DR. PETER ADLER,* DEBRECEN, HUNGARY

DURING orthodontic treatment, teeth are often to be displaced individually. As they are attacked by the force of the orthodontic appliance in their coronal portion, a movement is brought about, generally called tipping (Guilford[1]), i.e., turning around an axis which is parallel to the occlusal plane, lying within the root portion of the tooth (Adler[2]). Other kinds of individual tooth movement, like straightening up, rotation around a longitudinal axis, bodily movement, shortening, and lengthening can be produced only by use of different auxiliary mechanisms.

As regards the position of the axis around which turning or tipping occurs, views of orthodontists differ considerably. Angle[3] contended that, for most movements, this axis lies at the apical end of the root, while Case[4] demonstrated by a simple model experiment that this view was untenable. A post was driven into the earth; by exerting a force upon its "coronar" portion, perpendicularly to its longitudinal axis, it can be stated that the "fulcrum" of this system lies not in the "apical" region but only somewhat deeper than the center of the "root portion." After histologic examination of deciduous teeth and their sockets in baboons after orthodontic movements, Oppenheim[5] stated that the axis of tipping teeth lies at the apical root end; thus he confirmed the views of Angle. The histologic evidence was based upon the presence and distribution of bone destruction and apposition. On the pressure side of the socket, bone destruction, and occasionally on the root surface, cement resorption take place, whereas in areas of traction new bone is formed Since, on the one side of the socket, bone destruction was found uninterruptedly onto the apical region, and on the opposite side apposition, the apical area itself showing no signs of tissue changes, Oppenheim[5] concluded that, in tipping, the resting point of the root is the apical end. It must be admitted that these histologic findings are no cogent evidence of the contended location of the fulcrum. It can be supposed, also, that, by the orthodontic appliance used in the preceding experiments, not only tipping of the tooth was brought about, but by interaction of the force of the device with forces due to growth, to occlusal stress, to muscular stress upon the most prominent part of tipped teeth, etc., a combination of tipping and straightening up was brought about. Thus, histologic sections studied by Oppenheim show perhaps the resultant of at least two elementary orthodontic movements. Though several objections were made by subsequent authors to the views of Angle and Oppenheim, this possible source of error was not taken into consideration. In newer experiments in man, the validity of these findings is restricted by Oppenheim[6] to the use of slight intermittent forces working not over four months. Subjecting the tooth uninterruptedly over a longer period to forces of similar range, or using stronger forces, the resting point of the root

*From the Stomatological Clinic of the University in Debrecen, Hungary.

is shifted toward the incisal, and the apical root end endures an excursion in reverse direction to that of the crown.

Contrary to Oppenheim's findings, in histologic examinations—again drawing conclusions from the presence and distribution of bone destruction and apposition, and further from the varying width of the periodontal space ("hourglass form")—A. M. Schwarz[7] stated that in tipping teeth the resting point of the root is between the apical and central third and not at the apical root end. He explained that Oppenheim's observations are erroneous as eccentric longitudinal sections of teeth and sockets were examined. Findings similar to those of Schwarz were produced among others previously by Sandstedt,[8] Johnson, Appleton, and Rittershofer,[9] later by Gubler,[10] etc. Oppenheim for his part objected that in most of these experiments unpropitious circumstances prevailed, allowing jiggling, and "unbiologic" forces were used. Oppenheim regards only those forces as biologic which cause teeth to tip around the apex.

The main argument for the general validity of the above findings contradictory to views of Angle and Oppenheim is the model experiment of Case and similar experiments and computations of some subsequent authors. Such experiments and calculations on schematic models were carried out, among others, by Schwarz[11] with a beam of uniform breadth, by Bauer and Langh[12] using a conical root, by Fickel[13] and Grubrich[14] using paraboloid roots. The fundamental preliminary assumption of all these authors was that the medium surrounding the tooth is homogeneous and compressible. A mathematical theory of individual tooth movements was developed by Synge,[15] using roots of different form. Though the medium surrounding the tooth was first supposed incompressible, later as of equal compressibility to water, it was assumed to be homogeneous by Synge as well as by Hay.[16]

It is a question to be clarified how far it is justifiable to draw conclusions of general validity from model experiments and computations relying on this fundamental assumption. First of all it has to be emphasized that for the adequacy of this supposition no evidence was produced either by the authors mentioned above or by anyone else. Angle[3] pointed out that this illustration of tooth movement "is a poor one, as the mechanical conditions are very different." In model experiments and in the mathematical analysis of tooth movement, according to A. M. Schwarz,[17] a strong distinction is to be made between movement of the tooth within its socket, and further displacements due to tissue changes in the bony walls of the alveolus. Experiments and computations concern only the first-mentioned movement, i.e., displacement of the tooth within the socket. In this case, the medium around the tooth in which movement takes place corresponds to the periodontal membrane.

A. First of all it will be examined how far the assumption of a homogeneous periodontal membrane—or, translated into terms of model experiments and computations, the assumption of a homogeneous periodontal medium—accords with practical experience, experimental and computatory results. Some facts are contradictory to this presumption:

1. In this respect the well-known publications of Ketcham[18] on root resorptions are to be mentioned. Ketcham found that root resorptions mostly occur

on the apices of upper incisors moved bodily. A peculiar susceptibility of these teeth to resorption was given as explanation which was doubted by subsequent authors. Without discussing the correctness of the explanation, the facts stated by Ketcham are taken for granted. Further, we accept that teeth were moved bodily in the strong sense of this term, i.e., parallel to their original position with lengthening or shortening (Adler[2]). The periodontal space is of a non-uniform width. According to findings of A. Klein,[19] it is narrowest approximately at the center of the root, being dilated toward the gingival and toward the apical, resulting in the "hourglass shape." As the root moves parallel to its original position, the strongest compression to the periodontal membrane is exerted in the region where the periodontal space is the most narrow; thus, most resorptions were expected to occur here. Nevertheless, according to Ketcham, resorptions were found in first line in the apical region.

Naturally, this discrepancy between logical expectations and empirical findings can be explained in different ways. A higher susceptibility of the apical cementum to resorption may serve as explanation. According to Gottlieb's[20] views, a diminished vitality of the cementum begins mostly at the gingival margin, resulting in periodontoclasia. Influences upon the vitality of apical cementum are exerted by infectious processes of the periapex (apical parodontitis, granuloma, cysts, etc.), But these processes have no connection whatever with root resorptions due to orthodontic movements. Thus, there is nothing in favor of this view. A further possibility of explanation is the assumption of a nonhomogeneous periodontal medium. Supposing the periodontal tissues to be more dense and less compressible in the apical region, it is quite evident that by parallel displacement of roots their apical ends are subjected to a higher pressure than other portions. Thus, without a special susceptibility to resorptions, destruction may take place in the apical region in consequence of the higher pressure endured.

2. Some facts are in favor of the view of a more dense and less compressible periodontal medium in the apical region.

In computations on schematic models, location of the resting point in the root was determined by most authors mathematically, supposing that the tooth is attacked by a force in its crown portion, perpendicularly to its longitudinal axis. In the model of Schwarz[11] (a rod of uniform breadth), the fulcrum is between the apical and central third of the root when the force is attacking the crown immediately at the gingival margin. The fulcrum, due to forces attacking the crown more incisally, is shifted toward the gingival but in a negligible degree. In the conical model of Bauer and Langh[12] under similar conditions, the resting point is the center of the root or at a more gingival level. The same is valid for paraboloid roots also (Fickel[13]). These findings are so far in conformity with those of Synge[15] and Hay[16] also.

It is quite clear that neither square beams of uniform breadth nor cones are adequate representations of the anatomical shape of natural roots. As roots became more slender toward the apex, their fulcrum—even under optimal circumstances—lies implicitly more incisally than computed for a rod of uniform breadth.

Nevertheless, in some histologic findings, the resting point of the root was found more apically than it could have been if results of model experiments were transmittable to teeth. By Schwarz himself the resting point in natural roots was found at the same level as the fulcrum in rods of uniform breadth.

By forces of adequate strength and with a long radius of action, by pressing the root to the border of the bony socket, the fulcrum is shifted further incisally, onto the marginal border. In periodontology Falck,[21] e.g., assumes the fulcrum of tipping teeth to be at this level. For orthodontics, when excluding gross damages to the supporting structures, movements of this kind are indisputable.

By Schwarz,[17] in early publications, the discrepancy between physical findings on the rod and the histologic findings of Oppenheim was explained by assuming strong fibers in the apical periodontium in order to secure the stability of the apex. Hereby the integrity of blood supply to the pulp is preserved in spite of tooth movement; thus, from a teleological point of view, this mechanism seems to be useful. In all instances, some structural differences between apical and marginal periodontal medium have to be adopted to explain the position of the fulcrum found histologically which was more apical than it could have been under most propitious circumstances in the model.

3. In a former paper[22] the author analyzed the physical conditions of bodily movement in connection with forces permissible in orthodontics. Hereby a simple method could be devised for comparing the charge to molar anchorage in two different devices, viz., the pin and tube appliances and an expansion arch with threaded end sections used in forward movement of incisors.

It is a matter of fact that, in moving four incisors forward bodily, the molar anchorage, when not re-enforced, becomes insufficient, while it is sufficient to tip the full set of incisors labially. It is further generally known that in the pin and tube appliance no more force is put into the arch wire than when incisors are tipped toward the labial.

Since action equals reaction, the orthodontic arch performs an equal work during tooth movement in the incisor and molar region when only these teeth are connected to it. Supposing the teeth to be embedded in a homogeneous medium of a consistency like gelatine, putty, or sand, the particles of which can be displaced without considerable resistance, the work performed during tooth movement can be expressed by the volume of the stereometrical body swept by the moving root. In such media, tooth movement occurs by displacing particles of the medium by the moving root. Naturally, more work is required to move a tooth over a longer distance, and, proportionally, more particles of the periodontal medium are to be displaced. Thus, a constant proportion can be taken for granted between the work performed during tooth movement and the volume of the stereometrical body swept by the root. The latter equals the sum of displaced particles.

Further particulars of this question may be looked for in the original paper mentioned. For our present purpose the results of computations are of chief interest. Choosing appropriate numerical values for length and breadth of

teeth, extent of their root surfaces, distances traveled by incisors, it could be shown that the ratio of loads to anchor molars equals approximately 1.7:1, i.e., in the pin and tube appliance about to 1.7 times more force is charging anchor teeth than when incisors are tipped toward the labial. This ratio was obtained by considering the anchorage of first molars only; therefore, surely, it differs somewhat from actual conditions. Nevertheless, this ratio is too small to be a complete explanation of the multitudinous experience in the insufficiency of molar anchorage in the pin and tube appliance and the sufficiency in tipping incisors labially. By change of the numerical values and adding the resistance of second molars, but little change of the ratio is obtained.

This unsatisfactory computatory result may be due to the fact that the preliminary assumptions of the computations differ considerably from natural conditions. Supposing the periodontal medium to be more dense and less compressible in the apical region, between loads to the molar anchorage in these two devices, a considerably larger difference could have been stated.

4. An experimental proof of the inadequacy of the view of a homogeneous periodontal medium could be produced by measuring threshold values of axial and lateral stress to teeth causing a well-defined sensible perception (Adler[23]). The ratio of axial to lateral stress threshold values in natural teeth ascertained experimentally differs from the ratio computed by relying on differently shaped models in a homogeneous medium. A table containing all necessary information may demonstrate this discrepancy in a more explanatory manner than long descriptions can do.

TABLE I. AXIAL AND LATERAL STRESS THRESHOLD VALUES, THEIR QUOTIENTS IN ADOLESCENTS AND IN DIFFERENT MODELS

	AXIAL STRESS THRESHOLD VALUE IN KG.		LATERAL STRESS THRESHOLD VALUE IN KG.		QUOTIENT $\frac{\text{AXIAL STRESS THRESHOLD VALUE}}{\text{LATERAL STRESS THRESHOLD VALUE}}$ IN			
					ADOLESCENTS		THE MODEL OF	
TOOTH	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	SCHWARZ	BAUER AND LANGH
Upper								
1	4.0	11.00	1.00	2.50	2.25	7.20	19.1	22.0
2	4.0	14.00	1.00	2.75	2.25	8.00	20.8	24.5
3	5.0	14.00	1.50	2.75	2.00	7.00	22.5	26.2
4	4.0	15.00	1.25	3.00	2.28	7.50	26.3	31.1
5	4.5	15.00	1.75	3.00	2.00	7.50	23.3	26.1
Lower								
1	5.0	12.50	1.50	2.50	2.22	6.86	18.4	24.9
2	5.5	13.00	1.50	2.75	2.22	6.29	24.2	28.7
3	6.0	14.00	1.75	3.00	2.00	7.43	25.7	33.6
4	6.5	15.00	1.75	3.00	2.17	8.00	19.6	22.5
5	7.0	15.00	2.00	3.00	2.33	7.00	18.0	20.6

Axial stress for both models was taken by division of the acting force, P, by the root surface as measured by Sakaguchi (Zbl. Zahn-Mund-Kieferhlk. 6: 319, 1941).

Lateral stress was computed in the model of Schwarz according to the formula $Q_{max} = \frac{2\,P'}{b\,w}\left(2 + \frac{3\,h}{w}\right)$ and in the model of Bauer and Langh $Q_{max} = \frac{3\,P'}{a\,w^3}\left(3\,w - 4\,k\right)$.

Here Q_{max} means the maximal pressure, P' the force acting perpendicularly to the longitudinal axis of the tooth, w the length of the root, k the distance from the apex in which the force is acting, and h the distance from the border of the socket in which the force is acting; b the average breadth of the root and a radius of the conical root in 1 cm. distance from the apex.

As regards average breadth of the root, length of the root, etc., data of Mühlreiter (Anatomie des menschlichen Gebisses, Leipzig, 1891, A. Felix) were taken into consideration.

The data of the table show that between computatory results and experimental measurements a wide discrepancy exists. In explaining this discrepancy we have to pay attention to the fact that all computations were carried out relying on the fundamental assumption of a homogeneous periodontal medium. The results of measurements are contradictory to it.

B. Summing up the foregoing explanations, it seems questionable whether the strong distinction between tooth movements within the socket and those due to tissue changes is justifiable. Some experiences of practical art are contradictory to this view also.

When incisors are moved toward the lateral bodily, by the pin and tube appliance, after activation of the device an anemic zone can be seen on the gums along the pressure side of incisors. In five to ten minutes this discoloration disappears, blood flowing again through the capillaries of these areas by aid of collateral vessels. Initially the patient fells a discomforting pressure in the periodontal tissues of incisors, but within a few minutes—when using adequate forces—this sensation ceases spontaneously.

Similar observations were made while measuring masticatory forces. If a tooth is charged by a load over thirty to one hundred seconds, the perceptions show a remarkable change even within this short time. Observations of similar nature can be made after activation of orthodontic devices, after inserting separators to teeth, etc. In all these instances an adaption of periodontal tissues to an altered load takes place, stopping uncomfortable sensations, resulting in restitution of circulation by aid of collaterals.

In all events, it is demonstrated hereby that by the immediate action of forces of a certain range exerted on the tooth, changes are caused not only in the periodontal membrane but also in other periodontal tissues, a view which was formerly generally valid in orthodontics (Angle[3]). These tissues together are called parodontium. If the parodontium is regarded as a clinical and biological entity, even without being an anatomical one (Weski[24]), in consideration of its anatomical and histological structure the assumption of a homogeneous periodontal medium is untenable. And thus untenable is the physical argument against the correctness of Oppenheim's findings.

Angle considered the changes due to orthodontic operations on single teeth to be of a twofold nature: (1) bending of the bone, and (2) tissue changes by cellular activity. The histologic examination of the latter leads to neglect of the former.

As regards tissue changes, within certain limits of force, they take place biologically. The physical limits were pointed out by the author.[25] According to histological findings of Stuteville[26] in this respect, not the strength of the force but the amount of distance through which the force is active* is of a determinant importance. When the latter is smaller than the width of the periodontal space, i.e., the thickness of the periodontal membrane, the former seems to be irrelevant. Under these circumstances, tooth movements can take place biologically. If the force is active for a great enough distance to obliterate the

*This distance is the "radius of action" of the force (Adler[25]).

blood vessels, even by 0.5 *g* force, root resorption may be caused. If the force is active for a longer distance than the width of the periodontal space, it is quite obvious that some deformation of bony walls of the socket occurs as the force is transmitted by stress and pull impulses with aid of the periodontal membrane to the alveolar bone. The presence of deformation, its degree and distribution, depend largely upon thickness, gross and minute anatomical structure of alveolar walls. Thus, it depends on anatomical and histological structure of the alveolar process in what proportion a force is consumed in immediate deformation (bending) of the bone and what ratio of force remains active for the permanent compression of the periodontal membrane. Considering these facts, we can take for granted that different reactions take place when exerting forces of different strength and radius of action to teeth even under analogous anatomical conditions. Thus, different location of the resting point in roots of tipping teeth under different experimental conditions may be due to physical facts. Photoelastic studies of Zak[27] are in support of this view.

By the foregoing explanations the negative side of the problem of model experiments on tooth movement is solved so far as it was demonstrated that the strong distinction between tooth movements within the socket and those due to tissue changes is untenable, and that periodontal media cannot be regarded as homogeneous. The next step to be taken is the construction of a schematic system with appropriately shaped root and with a periodontal medium which permits, under certain circumstances, a tipping around the apex and offers computatory results in agreement with practical and experimental experiences. To do this is our aim.

In this paper, contradictions to the present view of models on tooth movement are summarized:

1. It has been shown that physical conditions of model experiments using a homogeneous periodontal medium do not accord with real conditions.

2. Some facts were presented by which the strong distinction between tooth movements within the socket and those due to tissue changes seems untenable.

This paper is devoted to the memory of Prof. A. Oppenheim, by whom the author received the first impulse before the war in Vienna to examine these problems.

REFERENCES

1. Guilford: Orthodontia: Quoted from Salamon, H.: Die Lehre von den elementären orthodontischen Bewegungen, Leipzig, 1912, Georg Thieme.
2. Adler, P.: Analysis and Systematization of Elementary Orthodontic Movements, Apollonian, in press.
3. Angle, E. H.: Treatment of Malocclusions of the Teeth, Philadelphia, 1907, S. S. White.
4. Case, C. S.: Dental Orthopedia, Chicago, 1908.
5. Oppenheim, A.: Die Veränderungen der Gewebe, insbesonders des Knochens bei Verschiebung der Zähne, Suppl. to Oesterr.-ungar. Vrtljschr. f. Zahnh. **27**: 303, 1911.
6. Oppenheim, A.: Biologisch-orthodontische Therapie und Wirklichkeit, Berlin and Wien, 1936, Urban & Schwarzenberg.
7. Schwarz, A. M.: Die Gewebsveränderungen bei orthodontischen Massnahmen, Fortschr. Orthod. **1**: 381, 540, 1931; and **2**: 11, 154, 1932.
8. Sandstedt, C.: Einige Beiträge zur Theorie der Zahn-regulierung, quoted according to Korkhaus, G.: Biomechanische Gebiss und Kieferorthopädie (Orthodontie), Handb. d. Zahnheilkunde von Bruhn, Vol. 4, München, 1939, Bergmann.
9. Johnson, A. Leroy, Appleton, I. L., and Rittershofer, L. S.: Tissue Changes Involved in Tooth Movement, INT. J. ORTHODONTIA **12**: 889, 1926.

10. Gubler, W.: Neuere Untersuchungen über die Wirkung der selbsttätigen Platte, Schweiz. Monatschr. Zahnh. **52**: 1060, 1942.
11. Schwarz, A. M.: Mathematische Ueberprüfung des Verhaltens belasteter Zähne, Ztschr. f. Stomatol. **26**: 398, 1928.
12. Bauer, W., and Langh, F. J.: Ueber das Wandern der Zähne, Vrtljsschr. f. Zahnh. **44**: 321, 1928.
13. Fickel, W.: Die Drehachse bei einwurzeligen Zähnen und deren Aenderung bei verschiedenen Balastungsrichtungen, Deutsche Monatschr. f. Zahnh. **48**: 1137, 1930.
14. Grubrich, W.: Veränderungen an orthodontisch bewegten Zähnen, Thesis, Tübingen, 1930.
15. Synge, J. L.: The Tightness of the Teeth Considered as a Problem Concerning the Equilibrium of a Thin Incompressible Elastic Membrane, Phil. Trans. Roy. Soc. London A. **231**: 435, 1933; The Equilibrium of a Tooth With General Conical Root, Phil. Mag. **15**: 969, 1933; The Theory of an Incompressible Periodontal Membrane, INT. J. ORTHODONTIA **19**: 2, 1933.
16. Hay, G. E.: Ischemia of the Periodontal Membrane, Oral Health, June, 1939.
17. Schwarz, A. M.: Ueber die Bewegung belasteter Zähne, Ztschr. f. Stomatol. **26**: 40, 1928.
18. Ketcham, C.: A Preliminary Report of an Investigation of Apical Root Resorption of Permanent Teeth, INT. J. ORTHODONTIA **2**: 97, 1927.
19. Klein, A.: Systematische Untersuchungen über die Periodontalbreite, Ztschr. f. Stomatol. **26**: 417, 1928.
20. Gottlieb, B.: Die diffuse Atrophie des Alveolarknochens, Ztschr. f. Stomatol. **21**: 195, 1923.
21. Falck, K.: Die Ueberlastungstheorie. Ztschr. f. Stomatol. **21**: 350, 1923.
22. Adler, P.: Ueber die "körperliche" Bewegung, Ztschr. f. Stomatol. in press.
23. Adler, P.: The Sensibility of Teeth to Loads of Different Direction, in press.
24. Weski, O.: Die chronisch marginalen Entzündungen des Alveolarfortsatzes mit besonderer Berücksichtigung der Alveolarpyorrhoe, Vrtljschr. Zahnh. **37**: 3, 1921.
25. Adler, P.: Die physikalischen Voraussetzungen der biologischen Zahnverschiebungen, Ztschr. f. Stomatol. in press.
26. Stuteville, O. H.: Injuries to Teeth and Supporting Structures Caused by Various Orthodontic Appliances, and Methods of Preventing These Injuries, J. A. D. A. **24**: 1494, 1937.
27. Zak, B.: Die photoelastische Analyse der Orthodontischen Mechanik, Ztschr. f. Stomatol. **33**: 22, 87, 1935.

SIMPLIFIED TECHNIQUE FOR SOLDERING INTERMAXILLARY HOOKS OR STOPS ON SMALL CHROME ALLOY ARCHES WITHOUT REDUCING TEMPER OF THE ARCH

ERNEST T. KLEIN, D.D.S., DENVER, COLO.

MATERIALS

Chrome alloy arches, usually 0.018
Chrome alloy solder
Chrome alloy flux
0.028 brass wire
Small needle (gas and air) flame used in regular soldering technique
Howe pliers No. 110

TECHNIQUE

File off the end of a straight piece of 0.028 brass wire, dip it into chrome alloy flux, and hold near the flame (*not into flame*) until the flux becomes clear and glasslike. Then apply a generous amount of chrome alloy solder to the end of the brass wire. Experience will dictate how much solder should be used. Solder must be applied to the brass under the glasslike bead. Plunge immediately into hot water. Remove flux with laboratory knife, or crush off between beaks of Howe pliers. (Fig. 1 illustrates the brass wire with chrome alloy solder on the end.)

File through the solder to the brass wire as illustrated in Fig. 2 to reduce the amount of solder and to expose the end of the brass wire which later will contact the chrome alloy arch.

At the point on the chrome alloy arch that you wish to place your intermaxillary hook or stop, place some chrome alloy flux and hold near the flame (*not into flame*) until the flux becomes clear and glasslike.

Holding the brass wire in your hand quite a distance from the flame to prevent the heat from making you hurry, place the solder on the brass wire *above* the chrome alloy arch at the point you have just fluxed and to which you wish to attach your intermaxillary hook or stop (see Fig. 3) so that, when heat is transmitted to the solder, gravity will cause it to flow down over the arch, forming a collar around it. Heat should be applied only on the brass wire, never on the chrome alloy arch, and some distance from the solder so that a minimum amount of heat will be conducted to the arch—in fact, only enough heat to cause the solder to flow around the arch. When the solder begins to flow and make a collar around the arch, draw the brass wire over the arch to a butt joint (see Fig. 4). Plunge into hot water and remove flux. (Solder must flow completely around the arch, forming a collar around it, since it forms a mechanical joint and not a chemical union.)

A flame never contacts the chrome alloy arch. The only heat to contact the chrome alloy arch is that which is transmitted to it through the brass wire, and that heat is only enough to cause the chrome alloy solder to flow around it. This amount of heat will not affect the temper of the chrome alloy arches, even 0.018 sizes.

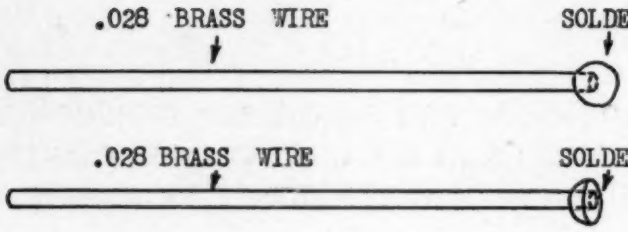

Fig. 1

Fig. 2

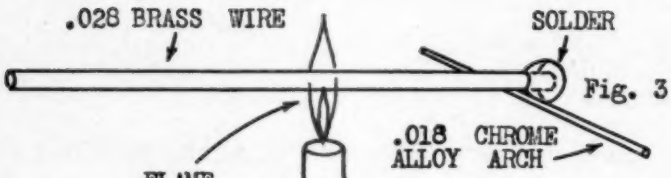

Fig. 3

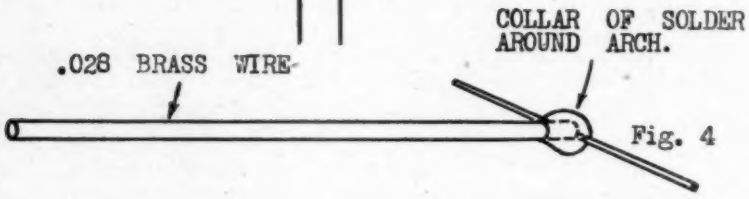

Fig. 4

Fig. 5

Fig. 5

To shape the intermaxillary hook or stop, hold the arch firmly with a Howe pliers or some other thin-beaked pliers, and bend the brass wire into any desired shape (see Fig. 5).

The writer wishes to express his appreciation to Dr. Charles H. Tweed, Tucson, Arizona, who is credited as being the first to introduce the use of brass wire for intermaxillary hooks and stops on chrome alloy arches, and also to Dr. William Roy Humphrey and Dr. George H. Siersma, Denver, Colorado, with whom the writer is associated, for their capable instruction of this technique which is used in their orthodontic practice.

REFERENCES

Humphrey, William Roy: Technic of Orthodontic Appliance Construction Using Chrome Alloy Metals, J. Am. Dent. A. August, 1936.

Bell, Brooks, and Siersma, George H.: Chrome Alloy Techniques, AM. J. ORTHODONTICS AND ORAL SURG. 27: 705, 1941.

1232 REPUBLIC BUILDING

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Inhibition of Dental Caries by Ingestion of Fluoride-Vitamin Tablets: By L. P. Strean and J. P. Beaudet, *New York State J. Med.*, New York 45: 2127-2238, Oct. 15, 1945.

Strean and Beaudet report clinical trials with calcium fluoride-vitamin D in children between the ages of 8 and 13. One hundred and seventy-one children were studied in the first series. These were divided into 3 groups of 57 each. The first group received a yellow tablet containing 3 mg. of calcium fluoride, 30 mg. of ascorbic acid, and 400 units of vitamin D as calciferol, one tablet a day; the second group received one white tablet containing only 3 mg. of calcium fluoride. The third group served as the control and did not receive any tablets. The experiment lasted for six months, and the study was limited to permanent teeth. Sixty children were studied in the second series. Thirty children were given one yellow tablet a day, and the other group of 30 served as controls and did not receive any tablets. This study was continued for eight months. The children in both series lived in an orphanage under similar conditions of diet, and each child had at least three cavities as judged by x-ray. In addition to these two series, tablets were given to a number of dentists who were to distribute them to patients between the ages of 8 and 16. Children between the ages of 8 and 16 not receiving fluorine in their water or food may expect on the average an increase of 40 to 65 per cent in the incidence of dental caries. When calcium fluoride was given to the children in the first series the increase in caries was reduced to 27 per cent, and when vitamins C and D were combined with the tablet, the incidence was reduced further to 24 per cent. In the second series, even though this experiment ran two months longer than the first one, the increase dropped to 10 per cent as compared with 24 per cent in the first experiment. It is suggested that this decrease may be explained by the synergistic action of vitamins C and D with fluorine. Fluoro-apatite may be absorbed from the surface of tooth enamel and is resistant to bacterial decomposition and lactic acid digestion. Fluorine combined with vitamins C and D in the form of a tablet offers a means of controlling the amount of fluorine to be ingested.

Clinical Study of Tetanus: Analysis of 121 Cases of Tetanus: By C. N. Gessler, *J. Tennessee M. A.* **38**: 363, October, 1945.

Gessler analyzed the records of 121 cases of tetanus treated in four hospitals in the twelve years between 1933 and 1944. The average incubation period of those who recovered was 16.44 days, while it was 10.24 days in those who died. Many cases that went on to recovery had a shorter incubation period than many cases in which recovery did not occur. The mortality rate was 53.7 per cent. More patients recovered among those who did not have prophylactic

first aid than among those who did. Thus, prophylactic treatment is disappointing. Intravenous or intramuscular injection of tetanus antitoxin is preferable to other routes of injection, 25,000 units for the average case. Intrathecal injection of antitoxin is more hazardous than effective. Local injection of antitoxin about the site of infection seems without value. The older theory of the ability of tetanus toxin to travel up nerve sheaths to reach the central nervous system has given away to the theory of blood stream circulation of the toxin. Hence, a liberal surplus of antitoxin injected into the circulation should neutralize the toxin being produced at the site of infection. The patient must have adequate sedation from the beginning of the disease. The use of sodium amytal and/or solution of tribromoethanol is satisfactory in most cases.

News and Notes

New York Society of Orthodontists

The next meeting of the New York Society of Orthodontists will be held at the Waldorf-Astoria Hotel, New York, on Monday and Tuesday, Nov. 4 and 5, 1946.

Pacific Coast Society of Orthodontists

The Pacific Coast Society of Orthodontists will hold its next general meeting in San Francisco, California, Feb. 20, 21, and 22, 1947.

J. CAMP DEAN, 1624 Franklin Building, Oakland, Calif., President.

Notes of Interest

Dr. Brooks Bell and Dr. Joe Favors announce the association of Dr. J. Frank Roark, 1208 Medical Arts Building, Dallas, Texas. Practice limited to orthodontics.

Dr. H. T. Berkey announces that Dr. John C. Miller will be associated with him in the practice of orthodontics, at 406-408 Wayne Pharmacal Building, Fort Wayne 2, Indiana.

Dr. J. Stier Cunningham announces the association of Dr. Byron N. Coward and the removal of their offices to 3718 Travis Street, Houston, Texas. Practice limited to orthodontics.

Dr. Russell E. Irish, orthodontist, announces the removal of his office to 5039 Jenkins Arcade, Pittsburgh 22, Pennsylvania.

Dr. Theodore Leonard Jerrold announces his association with Dr. Harry E. Jerrold, Professional Building, Hempstead, New York, and 359 New York Avenue, Brooklyn, New York. Practice limited to orthodontics.

Kenneth E. Lawrence, D.D.S., announces the opening of his office at 6305 Brookside Plaza, Kansas City, Missouri. Practice limited to dentistry for children.

Ernest W. Anderson, D.D.S., M.S., announces that he has been released from duty in the Dental Corps, United States Navy, and will resume the exclusive practice of orthodontics in association with Frank M. Casto, M.D., D.D.S., 801 Silverado, La Jolla, California.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

President, Archie B. Brusse - - - - - - - - - - - 1558 Humboldt St., Denver, Colo.
President-Elect, Earl G. Jones - - - - - - - - - - 185 East State St., Columbus, Ohio
Vice-President, Will G. Sheffer - - - - - - - - - Medico-Dental Bldg., San Jose, Calif.
Secretary-Treasurer, Max E. Ernst - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Central Section of the American Association of Orthodontists

President, C. S. Foster - - - - - - - - - - - - 803 Dows Bldg., Cedar Rapids, Iowa
Secretary-Treasurer, L. B. Higley - - - - - - - - 705 S. Summit St., Iowa City, Iowa

Great Lakes Society of Orthodontists

President, Willard A. Gray - - - - - - - - - - Medical Arts Bldg., Rochester, N. Y.
Secretary-Treasurer, C. Edward Martinek - - - - - 661 Fisher Bldg., Detroit, Mich.

New York Society of Orthodontists

President, Glenn H. Whitson - - - - - - - - - - 80 Hanson Pl., Brooklyn, N. Y.
Secretary-Treasurer, Oscar Jacobson - - - - - - - 35 W. 81st St., New York, N. Y.

Pacific Coast Society of Orthodontists

President, J. Camp Dean - - - - - - - - - - - 1624 Franklin St., Oakland, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - 450 Sutter St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Henry F. Hoffman - - - - - - - - - 700 Majestic Bldg., Denver, Colo.
Secretary-Treasurer, George H. Siersma - - - - - 1232 Republic Bldg., Denver, Colo.

Southern Society of Orthodontists

President, J. E. Brown - - - - - - - - Merchants National Bank Bldg., Mobile, Ala.
Secretary-Treasurer, Leland T. Daniel - - - - - 407-8 Exchange Bldg., Orlando, Fla.

Southwestern Society of Orthodontists

President, Brooks Bell - - - - - - - - - - - Medical Arts Bldg., Dallas, Texas
Secretary-Treasurer, James O. Bailey - - - - - Hamilton Bldg., Wichita Falls, Texas

American Board of Orthodontics

President, Frederic T. Murlless, Jr. - - - - - - - 43 Farmington Ave., Hartford, Conn.
Vice-President, Joseph D. Eby - - - - - - - - - 121 E. 60th St., New York, N. Y.
Secretary, Bernard G. deVries - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
Treasurer, Oliver W. White - - - - - - - - 213 David Whitney Bldg., Detroit, Mich.
James D. McCoy - - - - - - - - 3839 Wilshire Blvd., Los Angeles, Calif.
Claude R. Wood - - - - - - - - - Medical Arts Bldg., Knoxville, Tenn.
James A. Burrill - - - - - - - - - 25 E. Washington St., Chicago, Ill.

In the January issue each year, the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY will publish a list of all of the orthodontic societies in the world of which it has any record. In addition to this, it will publish the names and addresses of the officers of such societies.